SOURCE BOOK FOR THE ECONOMIC GEOGRAPHY OF NORTH AMERICA

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BY

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PREFACE

There has been a notable increase in recent years in the number of universities and colleges which offer instruction in geography, and especially in the numbers of students who elect courses in the subject. As a result, instructors have been confronted by the difficult problem of providing source materials for the use of their students. At the University of Chicago this problem has been especially critical in the course on the "Economic Geography of North America." Source materials in this field are scattered widely through government reports, magazines, and other publications, of which it has been impossible to provide a sufficient number of copies to meet the needs of large groups of students. Furthermore, much of the original literature is unrelated to a geographic discussion, so that it is impracticable to refer beginning students to it. It is hoped that this book will furnish material for an introductory study of the geography of North America and that it will effectively introduce students to the literature of the subject.

At the University of Chicago the course on the "Economic Geography of North America" is the third of three units which comprise the first year's work in geography. The preceding units are "Elements of Geography," which is an analysis of the elements of the physical environment in their relation to life, and "Economic and Commercial Geography," which is organized on a commodity basis. As given here, the course on North America is organized on a regional basis and serves as an introduction to regional geography. It is followed by courses on the other major regions of the world. Pedagogically, it is intended that this course constitute a transition from the earlier courses in which much use is made of a text to later courses without texts, in which the lecture method is employed more or less extensively.

As the limitations imposed by a small volume made it impossible to reproduce most of the articles in full, it is hoped that instructors using the book will consult the original sources and, when practicable, refer their students to them. All the material included in the book

has been tested repeatedly in class use as it advanced from "reading lists" through mimeograph and preprint editions to its present form.

While an attempt has been made to include material which constitutes a fairly comprehensive survey of the more important parts of the continent, it will be apparent at once that the book should be supplemented by wall maps and other illustrative material. Among the more useful maps are J. Paul Goode's Physical and Political Wall Maps of North America and the United States (Rand McNally & Co., 1914, 1915), V. C. Finch's Industrial Series of Wall Maps of the United States (A. J. Nystrom & Co., 1920), and Philips' Comparative Wall Atlas of North America (George Philips & Son, Ltd., Denoyer-Geppert Co., Agents).

Many of the selections included are intended to serve as a basis for a geographic discussion, rather than as a geographic discussion. In other words, much of the material as it stands is not strictly geographic in character, having been written for a variety of purposes, and it therefore remains for the instructor to make it function geographically. The book does not, then, constitute a course in the "Economic Geography of North America," but furnishes some of the material required by such a course.

I am under heavy obligations to the many authors and publishers who generously permitted the use of their articles, or of excerpts from them. Their names appear from page to page. Special acknowledgments are made to the American Geographical Society, the Editor of the *Journal of Geography*, the Department of Trade and Commerce and the Commission of Conservation of Canada, the United States Geological Survey, the Office of Farm Management of the United States Department of Agriculture, and to Professor R. H. Whitbeck of the University of Wisconsin. In the preparation of the volume, I am indebted to Miss Alice Foster, Assistant Professor-Elect in Mount Holyoke College, Dr. Helen M. Strong, Assistant Professor of Geography in the University of Missouri, and my colleague, Dr. Robert S. Platt, for assistance in the selection and organization of material and for testing it with their students. I am especially indebted to Miss Foster for her article on the "Geographic Regions of Mexico," and for her adaptation or translation of a number of articles by Spanish writers.

CHAS. C. COLBY

UNIVERSITY OF CHICAGO
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THE POINT OF VIEW

The materials in this book constitute a basis for an introductory survey of the economic geography of North America. In order that they be used effectively it is essential that the point of view which governed their selection be understood. The thesis fundamental to this point of view is that

Geography
is
The Relation of
Natural Environment→ to ←Human Activities

↓	↓	↓
Economic Activities	Social Activities	Political Activities

As the title of this book suggests, the present survey of North America is concerned primarily with the first part of this general field, namely, the *relation* of the natural environment to economic activities. It is apparent that if attention is to be focused on such relationships, a knowledge of the component elements of the natural environment of the several regions of the continent and of the outstanding economic activities of these regions is essential. It is in supplying this knowledge that the material in this book and other relevant material functions. It furnishes the basis of fact essential in obtaining for each part of the continent (1) regional concept, x, of the natural environment, (2) regional concept, y, of the economic activities, and (3) of establishing the relation of x to y.

An interpretation of economic activities in terms of the natural environment, although based on concrete facts and statistics, is such an abstract and complicated problem that considerable geographic training is requisite to its solution. Unless this training be sufficiently extensive to enable the student to visualize the problem so clearly that a definite point of view is insured, the survey is liable to degenerate into a cyclopedic enumeration of features of the natural environment on the one hand and of industrial and commercial statistics on the other. Such training includes (1) a working knowledge of the elements of the natural environment (elements of geography) and

(2) their relation to the production of, trade in, and utilization of the major commodities on which the industries and commerce of a region are based. These types of geographic training are so significant to the present point of view that each must be stated concretely.

The elements of the natural environment are named in various ways by geographers but practically all agree on some combination of the following items:

Elements of the Natural Environment

1. Position
2. Area
3. Climate
4. Relief
5. Soil
6. Waters of the lands
7. Minerals
8. The oceans
9. The coasts
10. Native vegetation
11. Native animal life

As listed here, the first nine of these elements commonly are classed as the elements of the physical environment. Certain of them, such as climate and soil, exert a profound influence on the distribution and nature of plant and animal life so that such life is, in one sense, as truly a response to physical environment as is human life. However, the forests and other native vegetation and insect and other animal life affect economic activities so definitely that, in this survey, they are thought of as conditioning factors and are classed with the elements of the physical environment. The entire group is viewed as the elements of the natural environment.

A thorough technical knowledge of these elements is essential to all significant geographic work. They are the alphabet of the geographer. Certainly without a knowledge of such geographic fundamentals as types of climate, relief, soil, etc., and their influence on human activities, it is futile to attempt either to gain a regional concept of the natural environment or to interpret the economic activities in terms of this environment. The student must be familiar with such typical geographic relationships as (1) the economic adjustments occasioned by the different types of climate, (2) the contrast of agricultural opportunities in plains and mountain regions, (3) the relation of drainage and underground water to rural and municipal water supplies, and (4) the character of coasts and their effect on ports and ship-

ping. Once a knowledge of the elements of the natural environment is attained it is possible to understand the way in which, in any region, certain of these elements are combined into an environmental complex or unit, the recognition of which constitutes the first phase of a regional survey.

The second type of geographic training essential to a survey of the economic geography of a region is illustrated typically by such concrete relationships as that of:

Climate Relief Soil Drainage	to the	Production of wheat, corn, or cotton

or of

Coking coal Iron ore Limestone	to the	Manufacture of iron and steel

This phase of geographic training also is concerned with an analysis of the major steps in the utilization of a commodity, as for instance:

The relation of

A		B		C		D
Climate Relief Soil Drainage	to	The production of wheat	to	Flour milling	to	Manufacture of specialized food products

or of

Climate Relief Soil Drainage	to	The production of cotton	to	Cotton manufacturing	to	Clothing industry

It is obvious that B is more concretely related to A than are C or D. This does not mean that A is unrelated to C or D but suggests that the approach to an interpretation of the relation of A to C or D is through an investigation of the relation of A to B. In such analyses it must be remembered that between steps A, B, C, and D there lies the item of transportation likewise influenced by geographic conditions and which, therefore, is an integral part of the analysis of a commodity sequence. The production and various phases of the utilization of some commodities occurs in one region. Other commodities

are produced in certain regions, manufactured in other regions and marketed in still others. In such cases, a commodity becomes an important item in world-commerce and the interpretation of its performance a complicated matter. The regions participating in this commerce are interrelated by their interest in this commodity and as a result conditions in a distant region may affect notably the economic activities surrounding the commodity in the region under consideration.

An interpretation of the industries growing out of the production and utilization of the principal commodities of commerce leads logically to an analysis and interpretation of the complex of industries established in a particular region. The number and scope of these industries varies greatly from region to region, depending upon the variety and extent of the resources of the region and the stage of development which it has attained. In a given region the industries may be based on the utilization of a single resource or on a number of resources. In general the complexity of the industrial structure of a region increases with the number of its resources which are being utilized. In some regions the products of such basic industries as farming, mining, or lumbering constitute the raw materials for other industries and, in turn, their products may be the basic materials for still other industries. In such regions the various economic activities are so interrelated and interwoven that an industrial or economic structure of great complexity results. A survey of the industrial complex (economic activities) of the several regions of North America constitutes the second phase of the present problem.

The third and central phase of this problem is to establish, for each region, the relation of the environmental complex to the industrial complex or, as originally stated, of natural environment to economic activities. In North America, as in the other continents, the difficulty of accomplishing this part of the problem varies greatly from region to region. In some regions the natural environment is so inauspicious to human occupation that industries practically are non-existent. In others, economic activities center about the production of a single commodity, while in still others, the resources of the natural environment are so varied and abundant that the resultant economic activities are correspondingly diversified and extensive. The Arctic Plain of Canada, the Prairie Plain of Canada, and the

Ohio section of the Interior Plain of the United States are illustrations of such varying degrees of complexity.

In the Arctic Plain of Canada the handicap imposed by the Arctic climate restricts the economic activities of the few widely spaced groups of primitive people who inhabit this broad, low, level, coastal plain to hunting and the sustenance phase of the fishing industry.

Economic activities on the Prairie Plain of Canada center about the production of wheat (see pp. 111–12). At the present stage of development this plain—broad, level, relatively low, fertile, well drained, lacustrine or glacial, semi-arid or humid continental with short summers—produces a huge surplus of wheat which is distributed to consuming regions in the United States and Northwest Europe.

The Ohio section of the Interior Plain of the United States presents a striking contrast to the foregoing regions. This plain—centrally located, broad, low, level, fertile, well drained, glacial, humid continental, originally forested, underlain with horizontally bedded sedimentary rocks bearing petroleum and contiguous to high-grade coal—constitutes a natural environment so favorable to human occupation that the economic activities are exceedingly varied and the problem of interpreting these activities in terms of the natural environment correspondingly complicated.

In carrying forward this investigation one of the problems is the selection of the regions for discussion. In this connection it must be realized that economic geography from a regional basis is in a pioneer stage of development and therefore much material essential to such a survey is not now available, and that the recognition of the center of interest in the several regions of the continent is more important than the delineation of their boundaries.[1] The material in this book is grouped into divisions which in a broad way correspond

[1] Obviously a direct relation maintains between the industrial development in a region and the density of its population. Consequently a map of the density of population suggests the more important regions. The following maps will be of assistance in this connection: (1) Population of North America, Philips Comparative Wall Atlas of North America; (2) Atlas of Canada, Department of the Interior of Canada, maps 27, 28, 29, 30; (3) Statistical Atlas of the United States, 1914, plate 15; (4) S. W. Cushing, "The Distribution of Population in Mexico," *Geographical Review*, April, 1921, map opposite p. 232; Mark Jefferson, "The Anthropology of North America," *Bulletin of American Geographical Society*, March, 1913, Fig. II.

to the larger geographic regions of the continent. The divisions made, however, only approximate the true geographic regions because the statistics on which much of the present survey must be based are available only by political divisions. It is hoped, however, that this material and other relevant material now available furnish the essentials for a discussion which will give the student a more precise knowledge of the geographic regions of the continent. If this be true, it should insure a regional concept of the relation of natural environment to economic activities which should be of assistance not only in further geographic work but also in investigations and interpretations of economic activities beyond the scope of geography.

CHAPTER I

REGIONAL CONCEPTS OF CANADA

1. SIZE, POSITION AND BOUNDARIES AS ENVIRONMENTAL FACTORS IN CANADA[1]

Canada is a large country. Her most southerly point is in 41° 41′, farther south than Rome; her northern boundary is hundreds of miles to northward of the magnetic pole; on the east, the "long wharf" of Cape Breton invites the argosies of Europe; on the west, she looks not without wonder and alarm toward the awakening East. Within a country extending over so many parallels and through so many meridians the geographical and climatic conditions are naturally varied; yet its very size gives to its main features a certain large simplicity. Of some of these features I hope to speak; but I wish to postulate its vast extent as a preliminary of all our thought.

This largeness has many results. . . . . The Maritime Province man still tends to speak of a journey westward as "going to Canada"; the parochialism of the French in Quebec has been strengthened by being a parochialism which covers 300,000 square miles; the British Columbian tries in vain to rouse the East to a full sense of the Yellow Peril. In the present discussions on the proposed reciprocity agreement with the United States the majority of the appeals are to sectional interests. Our size colours our whole existence. You can get change of air in England by going from London to Brighton, from Oxford to Boar's Hill; in Canada the wide sameness of our scenery makes necessary a far longer journey; in England the London newspapers have a position quite impossible for any Canadian journal.

Connected with her size is her position as a halfway house, which makes her economically the most favourably situated of all the newer countries. "The greatest market of the world for all kinds of products is Europe. According to Lloyd's Calendar, it requires from 36 to 42 days for mails to pass from the principal ports of

[1] Adapted from W. L. Grant, "Geographical Conditions Affecting the Development of Canada," *Geographical Journal*, XXXVIII, 362–69. Mr. Grant is Principal, Upper Canada College, Toronto.

New Zealand to London, the hub of the European markets; from 26 to 33 days from the principal ports of Australia to London; from 17 to 22 days from the ports of South America; from 17 to 21 days from the ports of South Africa; from 14 to 16 days from the ports of India; but only from 7 to 8 days from the principal ports of Canada. . . . . The market second in importance is that of the United States, and as regards this market none of the newer countries are so favourably situated as is Canada. Japan and China form the market third in importance, and with regard to this market also, Canada is as favourably situated as any of the newer countries, and much more so than most of them. Canada lies midway between two of the world's greatest markets, and is separated from the third only by an imaginary boundary-line."

In Canada man is making a nation in defiance of geographical conditions. If a committee of wise men, in the pure light of reason, were to divide the world into nations, Great Britain and Australia would probably remain as they are; but no sane man would, if asked to divide North America into three nations, draw the present boundary-line between Canada and the United States of America. On the east the Maritime Provinces form part of the great Appalachian mountain system. Under the early French explorers New England and Acadia were looked on as one; only the accidents or the fate of history have forced them apart, to the economic detriment of both.

After this rending apart of what geology had joined together, we have for a time a natural frontier in the St. Lawrence and the Great Lakes. Thence to the Lake of the Woods the boundary is a complicated maze of lakes and rivers, whence it follows the forty-ninth parallel to the Pacific. As far as the Rocky Mountains this artificial boundary coincides strikingly with a natural division. In a sense it is true that the prairies of Canada are a part of the great central plain, and that the Minnesota or Dacotah farmer who emigrates to Canada finds no change in soil or climate; but it is also true that, with the exception of the Red River, which has cut its slow course through the almost level prairie, and of the Milk River in western Alberta, the forty-ninth parallel coincides strikingly with the watershed separating the streams which flow into Hudson Bay from those which form the headwaters of the Mississippi and Missouri; it is

thus in a very real sense the great inland sea of Hudson Bay which gives unity to the whole central portion of Canada.

The Cordillera once reached, however, the line not only cuts across a great natural feature of the continent, but does so at a point where the mountain masses are particularly knotted and impenetrable. Vancouver Island has fortunately been given to us in its integrity, though our American cousins wished the forty-ninth parallel to continue its course to the open sea.

Not only is the boundary thus artificial, but great natural barriers intervene between the districts which in the early days were most open to cultivation. Between New Brunswick and the cultivated part of Quebec is thrust up a tumbled mass of river, lake, and crag 500 miles wide; between Old Ontario and Manitoba is the long inhospitable stretch of Laurentian rock, in which settlement is, and always must be, thin and scattered. Between the fertile valleys and tree-clad slopes of British Columbia and the rest of Canada stretches the gaunt barrier of the Rockies. Well might the cynic describe the country as "four separate projections of the cultivable and habitable part of the continent into Arctic waste."

Thus when, in 1867, the Dominion of Canada was formed by the union of Nova Scotia and New Brunswick to Upper and Lower Canada, one of the terms of the Act uniting them was the building by the Canadian government of a railway from Quebec to Halifax. In 1876 the Intercolonial Railway was opened, and has since been extended to Montreal. Built rather for political than for economic reasons, not seldom the prey of patronage-broking politicians, it was long a financial burden. But its management is improving, and with the steady progress of the country it may yet be a valuable asset. In any case a few deficits are a small price to pay for political unity.

The Intercolonial was less than half completed when a greater project was broached. The vast domain over which the Hudson Bay Company had ruled since 1670 was taken over in 1870 by the Dominion; overtures for union were made to British Columbia, and in 1871 the Pacific province entered the new nation, on condition that it should be bound to it with links of steel.

With the completion of the Canadian Pacific Railway, Canada stretched from Atlantic to Pacific, and attained length without breadth. In 1886 Canada was still a mere fringe along the border

of the United States; for the size of a country is measured not in square miles, not even in habitable square miles, but in accessible square miles. In modern times the true boundary of a country is never far from railhead.

This linear character of the country was increased by a great mistake of the builders of the railway. By the original surveys it had crossed the Rockies by the easy gradients of the Yellow Head Pass; the new company abandoned this route for the present line through the more southerly Kicking Horse and Rogers passes. The reason has never been made public. Perhaps even these great men had no hope of the supposedly frozen north; more probably the reason was political, a desire on the part of the Conservatives to take at all costs a different route from that chosen by the Liberals. When business and politics become intertwined, it is usually to the detriment of both. By their decision the company was compelled to pass through the semi-arid strip of southern Alberta and to retard for nearly twenty years the development of the real West. They were compelled to pierce the mountains just where the Cordillera is most knotted and tangled, to incur vast expense in surmounting the most terrible engineering difficulties, to build gradients on which three engines must be used for each train.

Slowly settlement came in and began to spread northward. The Canadian Pacific Railway showed fine energy, double-tracked parts of its line, built or bought branches, till the 3,000 miles of 1885 have grown into 13,000 in operation today. Yet both politically and economically it became inadequate, and early in this century the government of Sir Wilfrid Laurier decided to co-operate with the Grand Trunk Railway in building a second Pacific line, to run north of the Canadian Pacific Railway, and open up vast areas in Quebec, Ontario, the Prairie Provinces, and British Columbia. Much of this line is now in operation, and its completion is hoped for in 1913. Meanwhile a private firm, that of Messrs. Mackenzie and Mann, had been partly buying and partly building railways in different parts of the Dominion, which they are gradually knitting together into a third great transcontinental system, the Canadian Northern. This also has been assisted by the government, though not to the same extent, and it is a striking monument to the sagacity and the enterprise of its promoters.

Thus, then, Canada is expanding northward. She is no longer a tapeworm, but rather resembles a wasp, with the waist at Winnipeg. Not a bale of goods, not an emigrant, can go from east to west without passing through that city. It is well for us that war between the British Empire and the United States is now—thank God!—practically unthinkable, for I know of no country in the world so easy to cut in two as Canada. A dash over seventy miles of flat country into an unfortified and unfortifiable city on an open plain, and Canada falls as hopelessly into two as a wasp hit by a carving knife. Luckily such a war is, as I have said, now almost as unthinkable as one between England and Scotland.

The opening up of a port on Hudson Bay would also help to relieve another Canadian disadvantage—the extremely limited available coast-line. To the south we face landwards, and most of our northern boundary is in the grip of the Frost King. On the east Montreal and Quebec are closed for between four and five months, and a narrow strip of Labrador, under the rule of Newfoundland, extends along the coast for hundreds of miles. Whether Newfoundland, sitting gaunt and desolate like a gair-fowl on her rock, will join the Dominion is still doubtful; but Canada should as soon as possible take over the governance of continental Labrador. Down our west coast, however, extends the long strip of Alaska, which, it is to be feared, forever curtails our Pacific frontage. Thus, though we have plenty of ports for all necessary commercial purposes, we are never likely to be a seafaring people in anything like the proportion of England or of New Zealand—a fact to be borne in mind in all considerations of a Canadian navy.

2. AGRICULTURAL REGIONS OF CANADA[1]

The portion of Canada, the climatic conditions of which are favourable to agriculture, may be divided into five great regions:

1. The Laurentian Plateau, consisting of the vast upland surrounding Hudson Bay and underlain chiefly by igneous rocks, such as granite, together with a less amount of hardened sediments.

[1] Taken from Wyatt Malcolm, "Geology in Relation to Agriculture in Canada," *Canada Year Book*, 1914, pp. 34–38. Mr. Malcolm is a member of the Geological Survey Branch of the Department of Mines of Canada.

2. The Appalachian region, occupying the Maritime Provinces and eastern Quebec and underlain by folded sediments and igneous rocks.

3. The St. Lawrence Lowlands of southern Quebec and southern Ontario underlain by nearly horizontal sediments.

4. The Plains region of Manitoba, Saskatchewan, and Alberta underlain by flat-lying sediments.

5. The Cordilleran region, the mountainous region extending from the Rocky Mountains to the Pacific Coast and underlain by folded sediments and igneous rocks.

These five regions have all been exposed to weathering for a long time. The Laurentian Plateau is the oldest land area of any great extent in Canada.

During the long ages that this Laurentian continent has been exposed, the area to the southeast, south, and west has been submerged for long periods beneath the sea, and great thicknesses of sandstones, shales, and limestones have been laid down. These sediments have been elevated subsequently above sea-level, certain sections such as southwestern Quebec, southern Ontario, and the plains of Manitoba, Saskatchewan, and Alberta rising so gently as to produce little disturbance of the rock strata; while in eastern Quebec, New Brunswick, Nova Scotia, and British Columbia the strata have been folded and crushed into mountain ranges and intruded by igneous rocks.

The soils derived from these rocks by long subjection to decomposing agencies were greatly disturbed in recent times by glaciation. Nearly the whole of Canada was covered by ice, which in the southern part of the country had a general southerly movement. The result of the glaciation was that great stretches of country were denuded of soil, and other areas received accessions of a great quantity of transported material. Toward the close of the Glacial period the outlets of many depressions were closed by lobes of the retreating glaciers and became filled with water. These lakes formed areas for the deposition of fine sediments, such as clay and silt, and on the final melting of the glaciers large stretches of level fertile land remained.

Laurentian Plateau. The most extensive physiographic unit of Canada is the subdued Laurentian Plateau. This is a gently sloping plateau of rather even surface, comparatively low and

seldom rising 2,000 feet above the sea. The hills breaking the even surface rise but a few hundred feet at most above the general level.

It is a great U-shaped area surrounding Hudson Bay and extends from the Atlantic Ocean, on the Labrador coast, west to a line running northwest through Lake Winnipeg, Lake Athabaska, Great Slave Lake, and Great Bear Lake. It extends south to Lake Huron and Lake Superior, and occupies nearly all the provinces of Ontario and Quebec, except the area southwest of a line running from Kingston to Georgian Bay, that part of eastern Ontario forming the angle between the Ottawa and St. Lawrence rivers, and that part of Quebec south of the St. Lawrence River.

This plateau is underlain by hardened sediments and igneous rocks. The latter are much more widespread than the former, and granitic types predominate. The rocks of this region are among the oldest rocks of which geologists have any knowledge. They are very resistant, and, although they have been exposed to weathering since very early in the earth's history, the inequalities in the surface features have not been wholly reduced. These inequalities have been augmented by glacial action. A further effect of glaciation was the denuding of much of this region of its soil. Generally speaking, therefore, the physiographic and soil conditions are not favourable to agricultural pursuits. Over a great part of the area, however, sufficient soil has been retained to support a forest growth, although insufficient for agriculture, and it is to be regretted that large stretches of such land have been depleted of their forests and have become dreary, barren wastes.

Within the plateau there are valleys where areas of softer rock have afforded a greater abundance of soil that has not been removed by glaciation, and beautiful cultivated fields lend a pleasing contrast to the surrounding forest. In places the sediments deposited in the basins of glacial lakes have reduced the inequalities of the surface and produced large level areas of arable land. Interesting examples of these are furnished by the Clay Belt of northern Ontario and Quebec, traversed by the Grand Trunk Pacific Railway, and by the flat section of country along the main line of the Canadian Pacific Railway a few miles north of Sudbury.

Appalachian Region. The Appalachian region occupies the hilly part of southeastern Quebec and the Maritime Provinces. Here

during remote geological ages the sedimentary beds of limestone, sandstone, and shale that had been deposited beneath the sea were folded into mountain ranges, and were much altered and hardened and intruded by igneous rocks. During long succeeding ages these mountains have been subdued, and little is left that may be regarded as mountains except (1) the Notre Dame Range of Quebec with a general elevation of 1,000 to 2,000 feet and with peaks rising above 3,500 feet, (2) the broken hilly country of the north-western part of New Brunswick, (3) a section of this province bordering the Bay of Fundy, and (4) a central ridge of Nova Scotia.

In the ordinary processes of erosion much of the loosened material resulting from rock decay was carried seaward, and in recent times glaciation denuded a great deal of the more elevated sections of country, leaving barely enough soil to support a forest growth.

In some places sediments have been deposited subsequently to the great folding processes of earlier ages; they are unaltered, easily attacked by weathering agencies and are overlain by an ample depth of soil. The soils of Prince Edward Island, the Annapolis-Cornwallis Valley and other sections are derived from these sandstones and shales of later deposition, the shales producing the clayey constituents and the sandstones yielding the sand that renders the soil porous and tillable. Calcareous slates have in places, such as in Carleton and York counties, New Brunswick, broken down into fertile soils. In eastern Quebec sufficient soil has been retained in the valleys to render the land arable.

The great fertility of the reclaimed marshes of Nova Scotia and New Brunswick is due to the fine silt deposited by the tides by which they were formerly submerged.

St. Lawrence Lowlands. The St. Lawrence lowlands consist of the generally level, arable land south of the Laurentian Plateau. This lies on both sides of the St. Lawrence above Quebec, reaching south to the international boundary, occupies the eastern part of Ontario, east of a line running southward from a point about fifty miles west of Ottawa, and forms that portion of Ontario lying southwest of a line extending from Kingston to Georgian Bay.

These lowlands are among the most fertile of Canada's agricultural sections. They are underlain by flat-lying shales and limestones,

which yield readily to weathering. The physiographic features are favourable, and the residual material derived from the decomposition of limestones and shales results in a fertile, calcareous, clayey soil. The loose surface deposits are of great depth, in places exceeding two hundred feet.

The lowlands were overridden by the great glacier. This glaciation, however, had apparently slight denuding effect on this part of the country, but served to mix the loose materials resulting from the weathering of the shales and limestones, and contributed the potash-bearing ingredients transported from the granitic areas of the Laurentian Plateau.

In some sections, as in the vicinity of the Great Lakes, sedimentation took place in large lakes, produced by the blocking of the outlets of the present lake basins by lobes of the retreating glacier. Recent sedimentation took place also over southwestern Quebec and eastern Ontario during submergence beneath the sea about the close of the glacial period.

Plains Region. The plains of Manitoba, Saskatchewan, and Alberta are underlain by nearly flat-lying shales and sandstones. These have weathered down into the clays and clay loams that have made the plains one of the great wheat-producing districts of the world. This part of Canada was also subjected to glaciation, but the great proportion of the surface deposits is derived from the underlying rocks.

Some large stretches of the Plains region were submerged by glacial lakes in which fine silts and clays carried down from the surrounding land and introduced by glacial streams were deposited. Such is the very fertile Red River Valley. This is a part of the bed of a great lake that extended from the Laurentian Plateau west to the Manitoba escarpment; it reached southward into the United States and northward one hundred miles beyond Lake Winnipeg.

The great fertility of the prairie provinces is due in part to the mineral constituents of the soil and in part to the great accumulation of nitrogenous organic matter, the remains of ages of vegetable growth.

Cordilleran Region. The Cordilleran region, extending from the Rocky Mountains to the Pacific Ocean, is underlain by igneous rocks of various kinds and sediments that have been folded into mountain ranges and much altered. The whole region remains mountainous

though the interior section is reduced to an elevated plateau. Agricultural pursuits are therefore limited to the valleys. In these there are numerous terraces composed of silt carried down by streams issuing from former glaciers, the latter acting as eroding agents on the underlying rocks. These valley deposits are fertile and are well adapted to fruit culture. The soil of the lower Fraser is a heavier soil and consists chiefly of alluvium.

3. LAND AND WATER AREA OF CANADA BY PROVINCES AND TERRITORIES AND TOTAL AREA OF NEWFOUNDLAND[1]

TABLE I

Provinces	Land	Water	Total Land and Water
	sq. miles	sq. miles	sq. miles
Prince Edward Island	2,184	....	2,184
Nova Scotia	21,068	360	21,428
New Brunswick	27,911	74	27,985
Quebec	690,865	15,969	706,834
Ontario	365,880	41,382	407,262
Manitoba	231,926	19,906	251,832
Saskatchewan	243,382	8,318	251,700
Alberta	252,925	2,360	255,285
British Columbia	353,416	2,439	355,855
Yukon	206,427	649	207,076
Northwest Territories	1,207,926	34,298	1,242,224
TOTALS:			
Canada	3,603,910	125,755	3,729,665
Newfoundland	....	....	42,734

The water area is exclusive of Hudson Bay, Ungava Bay, the Bay of Fundy, the Gulf of St. Lawrence, and all other tidal waters, excepting that portion of the St. Lawrence River which is between Pointe-des-Monts in Saguenay and the foot of Lake St. Peter in Quebec.

4. TYPES OF CLIMATE IN CANADA[2]

The climatography of the Dominion of Canada deals with widely varying conditions within the northern half of the continent of

[1] *Canada Year Book*, 1918, p. 87.

[2] Adapted from R. F. Stupart, "General Survey of the Climate of Canada," *Canada Year Book*, 1914, pp. 128–34. Sir Frederick Stupart is Director of the Meteorological Service of Canada.

North America. Stretching from the Atlantic to the Pacific, from the United States boundary to the Arctic Ocean, this great area exhibits such a great diversity in topographical features that he who traverses it must meet with even greater changes of climate than would naturally follow from variation in latitude and distance from the oceans. Of these features the most important are the lofty mountain ranges which parallel the Pacific Coast, and cause the continental type of climate to predominate over the Dominion, the true maritime type being confined to the immediate coast-line of British Columbia.

British Columbia. Vancouver Island, in the Pacific Ocean, occupies somewhat the same position in relation to the American continent that Great Britain, in the Atlantic, does to Europe, lying between nearly the same parallels of latitude. The climate, as in all parts of British Columbia, varies much with the orographical features of the country. The annual rainfall along the exposed western coast of the island is very great, generally exceeding one hundred inches, but in the more eastern districts it is less than half that amount. A comparatively dry period extends from May to September, while copious rains fall between September and March. The mean monthly and mean annual temperature corresponds very closely with those found in parts of England; the summers are quite as long, and severe frosts scarcely ever occur.

The change in climate between the west and east sides of the Coast Range is decidedly abrupt. The Pacific winds are deprived of much of their moisture in ascending the western slopes of the mountains, and the air flows eastward or is drawn down to lower levels, becoming drier and warmer; hence the interior plateaus between the Coast and Selkirk ranges possess a relatively dry climate; the summers are warmer and winters colder than on the lower mainland. The cold of winter is, however, scarcely ever severe, and the hottest days of summer are rendered pleasant by the fact that the air is dry and the nights are cool. In all the lower levels of British Columbia, March is distinctly a spring month. In the more southern divisions the mean temperature of April corresponds very nearly with that of the same month in England, while the summer may very well be compared with that of southern Ontario, except that the air is much drier and the rainfall is scant.

The Sub-Arctic. To the northward of the provincial boundaries, in latitude 60, there are immense territories where the climate is of a sub-arctic type, with modifications in certain localities. The most striking of these occurs in the valley of the Mackenzie River. Where the summers are comparatively warm wheat has matured within the Arctic circle, and certainly vegetables may be grown quite generally. It is not improbable that these mild conditions obtain over all the territory between the river and the Rocky Mountains. The winters are, however, extremely cold, and while snow is disappearing rapidly and wild fowl are flying in April, it is May before there is much sign of growth, and after severe frosts in September winter sets in in October. The summer rainfall is scant over all the northern country, and the winter snowfall is by no means heavy.

Alberta. It is doubtful whether there is any other territory on the surface of the globe with a winter climate as variable as in this province. The normal winter is cold, and in some years extreme cold is continuous from November to March, but in other years the chinook is most persistent, and warm days with bright sunshine are the characteristic features of the winter. The chinook is one of the most characteristic features of the Alberta climate, and usually occurs with strong southwest and west winds. It is most frequent in the south, but is by no means uncommon even in the Peace River region. Sometimes a change of wind from north and northeast to southwest, will in Alberta mean a rise of temperature from perhaps 20° below zero to 40° above in a few hours. Largely to the effect of this wind is due the fact that the prairies of southern Alberta are usually bare of snow during the greater part of the winter.

Saskatchewan. The southern half of this province is almost wholly prairie land, and it is only to the northward of the Saskatchewan River that any extensive forest areas are found. The climate is similar to that of Manitoba, except that the southwestern portion is more arid, has an earlier spring and at times the winter temperature is affected by the Chinook.

Manitoba. The province of Manitoba is almost in the center of the continent, about midway between the Atlantic and the Pacific oceans, and also midway between the Gulf of Mexico and the Arctic Ocean. It is many hundreds of miles distant from any high mountains, and there are no important water areas to the westward.

The topographical features of the province are not pronounced. About two-thirds of the total area, including the basins of Lakes Winnipeg and Manitoba, are at a level of less than 1,000 feet, while to the westward the levels increase gradually to about 1,600 feet, with some few districts a little higher.

The very pronounced contrast between the continental and littoral type of climate is well evidenced by the fact that the mean range in temperature between the warmest and the coldest months of the year is 71° at Winnipeg, while it is but 21° at Victoria, British Columbia. The absolute recorded range of temperature at Winnipeg is 150°. A change of temperature of 40° in twenty-four hours is not very exceptional in winter in Manitoba, and a range of 49° has been registered. Very pronounced also are the departures from the normal winter temperature in corresponding months in different years, there being a January on record with the mean temperature 8° above normal, and another with a mean temperature 13° below normal, and a February with a mean temperature 25° above normal and also one with the mean 13° below normal.

As will be obvious from the figures just given, the change from winter to spring and summer is more rapid than in Great Britain or Western Europe, and frequently an April which is wintry at the beginning ends with conditions approaching those of summer. An average April is not so warm a month in Manitoba as it is in England. The season is not, however, so backward as the monthly mean temperatures might seem to indicate. The daily range is large, approximately 25°, and while the nights are cold, the day temperatures are high; the frost soon leaves the ground and the farmer may commence sowing. The mean temperature of May is as high as in the south of England, with the mean maximum considerably higher, and while frosts occasionally occur they are seldom severe. Light snowfalls also occur in this month, and at times are accompanied by high winds, but these storms are seldom injurious to agriculture.

June is characterised by warm days with frequent showers, which produce an almost phenomenally rapid growth, which continues through July. Few summers go by without several heat spells, during which the temperature rises to 90° or over, and in August, 1886, 103° was recorded at Winnipeg.

The mean annual amount of precipitation in Manitoba is about 19 inches, the heaviest about 22 inches, occurring in the extreme eastern portion, and the least about 17 inches, in the more southern and western districts. As, however, most of the precipitation, especially the summer rainfall, comes from local storms, there is sometimes a considerable difference in the amounts recorded at places not far distant from each other. Between 9 and 10 inches of rain, or approximately 50 per cent of the total annual precipitation, occurs between May and August, and is nearly equal to the amount that occurs during the same period in Ontario and in the midland counties of England. At Winnipeg the greatest annual precipitation recorded was 29.24 inches in 1878, and the least 14.38 inches in 1886, in which year only 4.23 inches fell during the May to August period. Most of the summer rainfall occurs in thunderstorms, which at times are quite heavy, accompanied by violent squalls and, less frequently, by hail. It is but very seldom that these storms attain the energy of the tornado, which is not uncommon on the more heated prairies to the south.

The snowfall of the Manitoba ranges from 52 inches in the eastern districts to 44 inches in the western districts, and while the ground is usually well covered from December to March, it is seldom that the depth is great. In most winters there are several heavy northwest gales succeeding the passage of cyclonic areas, and in these storms, as the temperature drops quickly, accompanied by a blinding drift of the dry snow, we have the well-known blizzard of the prairies.

Ontario. The province of Ontario alone is a vast territory, stretching over 15° latitude from a point in the same parallel as Rome, Italy, to a point in the same parallel as the north of Scotland, with a breadth including 20° of longitude. The almost entire north and east shores of the Great Lakes belong to Ontario, and its lands form about half the west shore-line of Hudson Bay. In portions of Ontario the climate is tempered by lake influence; other portions are affected by the northern inland sea, and other portions again are exposed to the severe cold waves from the far northwest, which in winter sweep with unchecked severity over the country north of Lakes Superior and Huron.

The climate of the peninsula of Ontario is much warmer than that of the northern parts of the province. The first part of March is

usually rather cold. Light snowfalls occasionally occur in April, but this month with a mean temperature of about 43°, three inches of rain and 190 hours of bright sunshine, is truly spring. With a high percentage of bright sunshine and ample rain, vegetation makes rapid progress during May. Frosts are quite infrequent, and by about the twenty-fourth most of the trees are in full leaf.

The summers, while warm, are not oppressively so. Wholly overcast and rainy days are of rare occurrence, the rain falling in showers and thunderstorms of short duration; indeed, from the middle of June until the end of August we may expect no day without a few sunny hours. The autumn sets in very gradually, and while frost may sometimes occur as early as September 20, it is usually well on in October before there is anything severe, and toward the end of November before the mean daily temperature falls to the freezing-point.

Northward and eastward, from Lake Ontario to the Ottawa valley, the spring opens somewhat later than in the south, but from mid-April on until the end of August, the temperature and rainfall are much the same as in the southern parts of the province, modified in certain districts by the effect of higher altitude, and in others by lying to the eastward of and in close proximity to the Great Lakes. September, however, shows a more rapid downward trend of the temperature curve. Killing frosts occur at an earlier date, and the whole northern country is usually snow-covered before the close of November, while in all southern counties it is still bare. The snow-covering is a most important factor in the industrial life of the more sparsely settled portions of the country where lumbering is carried on, since without snow the work is at a standstill during the cold weather, and the watercourses are not sufficiently in flood during the spring months to float logs to the major streams.

Quebec. The province of Quebec, like Ontario, covers an immense area, being included between 22° of longitude and extending from latitude 45° to the barren lands of Hudson Strait. The southwestern districts of the province, which are the warmest, are not, as in the Ontario peninsula, protected by the Great Lakes, and hence the winters are considerably colder, and the autumnal frosts occur a little earlier.

The Maritime Provinces. These have a climate which is in many respects comparable with that of southern Ontario, but there are

important differences. The spring opens somewhat later near the sea and in a latitude somewhat higher, and then again the summers, while a little warmer than in the south of England, are rather cooler than in the peninsula of Ontario. Temperatures exceeding 85° and at times 95° are by no means infrequent during the summer months. After September the temperature declines quite rapidly, and while October is a month of much finer weather, night frosts are likely to be severe, and toward the close of November the normal daily temperature falls below the freezing-point.

The winters in Nova Scotia are not quite as cold as in southern Ontario, but over the greater part of New Brunswick they are colder. The precipitation, which is ample throughout the provinces, is heaviest along the south shore of Nova Scotia, where it exceeds 50 inches, while between 40 and 45 is more general. The snowfall is very heavy in northern New Brunswick, where it exceeds 100 inches, and diminishes southward toward Nova Scotia, where the precipitation accompanying winter storms is usually partly in the form of rain.

5. MINERAL RESOURCES OF THE MAJOR PHYSIOGRAPHIC PROVINCES OF CANADA[1]

Canada may be divided into six great regions, each distinguished by a certain uniformity of broadly developed physical and geological features and characterized by the presence of special types of mineral deposits. One region, known as the Laurentian Plateau, includes approximately one-half of the area of Canada. It extends, with constantly diverging east and west boundaries, from the districts about Lake Superior, northward to the Arctic Ocean. This great expanse of country, situated towards the center of Canada, is occupied almost exclusively by rocks of pre-Cambrian age, that is, belonging to the oldest of the great systems of strata exposed over the surface of the earth. Over considerable areas the ancient measures are preserved with many of their original characters, but over other great stretches of country the strata have been folded, con-

[1] Adapted from G. A. Young, "The Mineral Resources of Canada." *Annals of The American Academy of Political and Social Science*, XLV (January, 1913), 136–50. Mr. Young is a member of the Geoloigcal Survey Branch of the Department of Mines of Canada.

torted and greatly altered. They have also been penetrated and enclosed by large and small bodies of granitic rocks now laid bare over the greater part of the region as the result of great cycles of erosion that have largely swept away the original covering of pre-Cambrian strata. The region of the Laurentian Plateau is, on the whole, an unknown country, but it is presumably rich in mineral wealth, since within the relatively narrow limits of the southern, better known portions, are situated many mines producing nickel, copper, silver, gold, iron, mica, graphite, etc.

The great central area of the Laurentian Plateau is bounded, except along the North Atlantic coast of Labrador, by stretches of plain-like country in some places lying at sea-level, in others rising to a considerable altitude. All of these areas are underlaid by nearly flat-lying, relatively undisturbed, sedimentary strata. These measures, during successive geological eras, were formed either in seas that surrounded and in part swept over the area of the Laurentian Plateau, or else were deposited in large bodies of fresh or brackish water or over flood plains during intervals of time while the regions in question were temporarily freed from the invading seas.

The areas encircling the Laurentian Plateau are divisible into three geological provinces. On the north, the Arctic Archipelago extends far northwards toward the North Pole. On the west side is the region of the Interior Continental Plain, the great wheat field of Canada. On the east side lie the St. Lawrence Lowlands, bordering the lower Great Lakes and forming the valley of the St. Lawrence River. Within these three regions metalliferous deposits are almost entirely wanting, but their absence is in a measure compensated by the presence of petroleum, natural gas and salt districts and, in the Interior Continental Plain region, of immense stores of coal.

The two still undescribed major geological provinces form respectively the eastern and western portions of Canada. Both are mountain-built provinces characterized by the presence of sedimentary and volcanic strata which, laid down with horizontal attitudes during various eras from pre-Cambrian time onwards, have since been flexed and faulted and invaded by bodies of igneous rocks. The eastern geological province is known as the Appalachian

region, and though much of the country may be truly termed mountainous, yet when compared with the western counterpart, it is more appropriately described as hilly. The western province is known as the Cordilleran region and includes the Canadian portion of the lofty, rugged, mountain systems that form the Pacific border of the whole length of the North American continent.

Both the Appalachian region on the east and the Cordilleran region on the west contain metalliferous deposits and coal-bearing strata, but the Cordilleran region is not only of much greater area, but is also much richer in mineral wealth. Within its bounds, in the northern portion, lie the world-famous gold fields of the Klondike. In the southern, better known portion of the region are many mining centers producing gold, copper, silver, lead, zinc, etc., while the region as a whole is rich in coal. The Appalachian region, though it is much poorer in coal than the western mountain province, yet annually produces nearly the same amount. The eastern region is also poorer in other respects, but contains the most important asbestos-producing area in the world as well as notable deposits of copper, gold, iron, etc.

Of the six major geological provinces, all, except the Arctic Archipelago, at the present time contribute to the mineral production of the country. In the following table is presented a statement showing for each division the approximate value of the mineral yield, exclusive of structural materials and clay products. These figures should not be taken as directly indicating the relative mineral wealth of the various regions, for the annual production of a district depends largely on conditions that are in a considerable measure independent of the extent and value of its mineral resources. Among such governing factors may be mentioned the presence or absence of transportation facilities and the activity of the market.

One striking feature brought out by means of Table II (p. 19) is the practically complete absence of metalliferous deposits in the regions of the St. Lawrence Lowlands and the Interior Continental Plain, for the trifling gold production credited to the latter region is placer gold, whose ultimate source lies outside of this geological province. A second point worthy of emphasis is the large coal productions credited to the Appalachian region in the east and the Cordilleran region in the west. The Interior Continental Plain

region in the near future will take rank as a coal-producing area with these two regions; for the present active development of this great wheat-growing region will inevitably lead to an energetic exploitation of its extensive coal resources.

TABLE II

Mineral Production (Exclusive of Structural Materials and Clay Products) by Geological Provinces, for 1910

Product	Appalachian Region	St. Lawrence Lowlands	Laurentian Plateau	Interior Continental Plain	Cordilleran Region
Gold	$166,456	....	$63,849	$1,850	$9,973,680
Silver	4,061	....	16,241,755	....	1,334,639
Copper	111,757	....	2,453,213	....	4,529,124
Nickel	....	....	11,181,310	....	....
Lead	....	....	....	....	1,216,249
Pig iron and iron ore	123,849	....	1,851,186	....	....
Coal	13,030,615	....	....	2,069,000	15,810,164
Asbestos	2,573,603	....	....	....	....
Petroleum and natural gas	1,826	$1,658,027	....	75,168	....
Gypsum	672,217	67,229	....	195,000	....
All others	169,226	593,951	908,784	....	118,243
Total	16,853,610	2,319,207	32,700,097	2,341,018	32,982,099
Per cent of total for Canada	19.3	2.6	37.6	2.7	37.8

The *Appalachian Region* has an area of approximately 80,000 square miles and includes the three Atlantic provinces of Nova Scotia, Prince Edward Island and New Brunswick, and also a large part of that portion of the adjoining province of Quebec situated on the southeast side of the St. Lawrence River. The extent of the mineral resources of a not inconsiderable portion of this region is still practically unknown, although the area in general was colonized at an early date and was the scene of some of the earliest attempts at mining in Canada.

In the Appalachian region coal is by far the most important product of the mine, for it furnishes slightly over three-quarters of the total annual value of the mineral production of the region exclusive of building materials and clay products. The coal is all of the bituminous variety and in distribution is confined to Nova Scotia and New Brunswick. In 1910 these two provinces produced slightly more than 6,500,000 tons, or a little over one-half of the

total tonnage produced in all Canada. Of the total production, about the whole came from four comparatively limited coal fields situated in Nova Scotia and nearly three-quarters of the amount was furnished by the Sydney coal field.

It has been estimated that the reserves of easily mineable coal in the Nova Scotian fields exceed 6,000,000,000 tons and that the New Brunswick fields may contain about 150,000,000 tons. Future developments may show a greater reserve of coal in the different fields or even lead to the recognition of new fields, but it seems entirely probable that the total coal resources will eventually be proven to be of the above-stated order of magnitude, and that the present Nova Scotian fields will continue to be the chief producers.

Next to coal, asbestos is at present the most important mineral product of the Appalachian region. The mining of this mineral is centered about the town of Thetford in southeastern Quebec, and from an area of a very few square miles is furnished the greater part of the total asbestos supply of the world. The commercial exploitation of the asbestos deposits commenced in 1878 and since then approximately 780,000 tons of asbestos valued at nearly $30,000,000 have been produced. Though the present fairly constant yearly rate of production entails the annual quarrying of approximately 1,500,000 tons of asbestos-bearing rock, yet the deposits give no indications of failing and a long future life seems assured.

The *St. Lawrence Lowland* region lies to the west of the Appalachian region, between it and the Laurentian Plateau. The region is the smallest of the six major geological provinces of Canada and has an area of approximately only 35,000 square miles. It consists of a series of plain-like areas situated in the provinces of Quebec and Ontario, and extending from Quebec City on the east, up the St. Lawrence Valley and along the northern sides of Lakes Ontario and Erie.

As already pointed out, the St. Lawrence Lowlands neither contain metalliferous deposits nor coal. But the region is by no means lacking in mineral wealth, for from the relatively small area of Ontario projecting as a peninsula between Lakes Huron and Erie, there are annually produced gypsum, salt, natural gas, and petroleum of the value of above $2,000,000. The gypsum deposits are relatively the least important of these, though the annual pro-

duction is steadily increasing and in 1910 amounted to a value of $67,000.

The salt beds of Ontario are known to underlie, though not continuously, an area of about 2,500 square miles bordering Lake Huron and Detroit River. The salt occurs at considerable depths beneath the surface. The amount present in the district in general must be enormous, for in places the beds are known to attain a thickness of two hundred feet. The salt is secured in the form of brine by forcing fresh water down bore-holes to the salt beds. In 1910 the amount of salt produced from this area reached above 80,000 tons valued at over $400,000.

The region of the St. Lawrence Lowlands contains large deposits suitable for the manufacture of brick, tile, cement and other structural and clay products. The value of the annual production of such materials is above $10,000,000.

The *Laurentian Plateau* borders the St. Lawrence Lowlands on the west and is the largest of the great geological provinces, its area being approximately 2,000,000 square miles. This region includes the greater part of the provinces of Quebec, Ontario, and Manitoba, a part of Saskatchewan and a very large part of the Northwest Territories. It centers about Hudson Bay and is triangular in outline, the base of the triangle fronting on the Arctic Ocean while the apex lies far to the south in United States territory south of Lake Superior.

The region is still practically a wilderness and within its bounds are great stretches of territory that have been traversed only by the explorer perhaps along a single water route. The portions that with any reasonable degree of accuracy may be claimed to be known, merely form a narrow fringe along the southern margin of the region.[1]

[1] The following is quoted from Mr. R. W. Brock, Director of the Geological Survey of Canada: "To realize the unprospected nature of the country, it is only necessary to remember that the greatest asbestos deposits of the world were brought to notice by blasting the Quebec Central Railway through them; that the greatest corundum deposits extending in a belt a hundred miles long, were found in a settled district by an officer of the Survey only twelve years ago [written in 1909]; that the Sudbury nickel deposits were discovered by putting a railway through them, that Cobalt, now the premier silver camp, although only a few miles from one of the earliest routes of travel in the country, and only a few miles from a silver-lead deposit known a hundred and fifty years ago, was discovered less than six years ago, and then only by means of a railway cutting through a rich vein."

Within this better, though very imperfectly known, portion are situated the greatest nickel-producing mines and the premier silver camp of the world. The possibilities in the way of mineral resources of this region will be further appreciated if it be added that in the limited portion of the region extending southwards into the United States are situated the richest copper camp and the most important iron-ore-producing area of the world.

Of the total mineral production of the Laurentian Plateau in 1910, nearly one-half, or above $16,000,000, is credited to silver produced from the Cobalt field of northern Ontario. Discovered as recently as 1903, this field has already produced silver to the value of $65,000,000 and the annual rate of production continues to increase, though possibly nearing a maximum. The ores of the camp occur in exceedingly rich, narrow veins. From one vein, in no place more than eight inches wide, there was extracted from an open cut 50 feet long and 25 feet deep, ore to the approximate value of over $200,000. The ores, besides containing native silver and compounds of silver with other elements, also contain large amounts of nickel, cobalt, and arsenic. For 1910 it is estimated that the ore mined contained, besides silver, 605 tons of nickel, 1,098 tons of cobalt and 4,897 tons of arsenic. It is stated that these ores form the principal source of the world's supply of cobalt. Some portion of the nickel contents is conserved, and in 1910 about 1,500 tons of arsenic were produced.

Next in rank to the silver mines of Cobalt are the nickel and copper-producing mines of Sudbury. Noticed in 1856 and rediscovered in 1883, the Sudbury field has since produced above 150,000 tons of nickel and 100,000 tons of copper. The ores also carry small amounts of platinum and palladium. These mines produce a very large part of the world's annual supply of nickel and the known ore reserves are very great.

The two districts of Cobalt and Sudbury in 1910 furnished minerals to the value of nearly $30,000,000, or approximately 90 per cent of the mineral production of the Laurentian Plateau. The remaining 10 per cent is derived from a large number of sources representing various products the present annual rate of production of which is not commensurate with their known value.

The region of the *Interior Continental Plain* borders the Laurentian Plateau on the west. It includes portions of the provinces of Mani-

toba and Saskatchewan, nearly the whole of Alberta, part of British Columbia, and extends northwestward through the Northwest Territories toward the Arctic Ocean. Along the international boundary this geological province has a width of approximately 750 miles and, with converging boundaries, it extends northwards for more than 1,100 miles. Its area is approximately 500,000 square miles.

Like the St. Lawrence Lowlands, the region lacks metalliferous wealth, but, on the other hand, is very rich in coal, it having been estimated that within the region there is at least 500,000,000,000 tons of mineable lignite. The lignite seams occur in various districts over the southern part of Saskatchewan and in many areas over nearly the whole of Alberta. In all, the areas containing mineable coal have been estimated to extend over 24,000 square miles, but coal seams doubtless underlie a total area much larger than this, though perhaps too deeply buried to be profitably mined. In 1910 approximately 900,000 tons of coal, all lignite, were produced from the region. The rate of annual production will undoubtedly show very marked increases for some time to come, concurrent with the rapid settlement of the territory now taking place.

Gypsum and natural gas are the only two products besides coal and structural materials that now contribute to the annual yield of the region. Deposits suitable for the production of brick, tile, cement, etc., occur at many points and, as a result of the rapid growth of population, are becoming of increasing importance.

The *Cordilleran Region* bounds the Interior Continental Plain on the west and extends to the Pacific. The region has an average width of about 400 miles and stretches from the international boundary northward for 1,500 miles to the Arctic Ocean. The region includes nearly the whole of British Columbia, all of Yukon Territory and part of the Northwest Territories; its area is approximately 650,000 square miles.

The Cordilleran region furnishes two-fifths of the total tonnage of coal annually mined in Canada; almost all the gold; practically all the lead and nearly three-fifths of the copper. Like its great rival, the Laurentian Plateau, the Cordilleran region is exceedingly rich in metalliferous deposits, but, unlike the eastern geological province, it also possesses vast stores of coal. As in the case of the

Laurentian Plateau, the western geological province is essentially an undeveloped, unprospected region. As yet only over a very limited area in the extreme south, and to a lesser degree along the Pacific Coast and the eastern border of the region, has prospecting advanced beyond the initial stages. Though much of the territory is still virtually unknown, the broader geological features have been determined and sufficient knowledge has been gained to firmly establish and warrant the belief that the region must be extremely rich in mineral wealth. Even at present, when traveling facilities, and therefore prospecting, are limited within relatively narrow limits, not a year passes without the discovery of deposits or mineral districts of importance.

The annual production of coal furnishes, in value, nearly one-half of the mineral production of the region, and in 1910 amounted to nearly $16,000,000. Of this amount less than one-quarter was furnished by the coal fields of Vancouver Island. Nearly the whole of the remainder came from coal fields situated in the East, in the Rockies or the foothills. Coal basins have been found at intervals from the international boundary northward along the range of the Rockies for a distance of 675 miles. The coal of these basins is bituminous in quality except in one limited field, where it is anthracitic. Many of these eastern coal basins are of large size and contain a number of thick seams. In one field the width of the outcropping coal is measured in terms of hundreds of feet. Basins containing lignite, and in one large district anthracite, occur throughout the length of the central part of the Cordilleran region. As already mentioned, coal basins occur on Vancouver Island; coal also occurs on the Queen Charlotte Islands. In all it has been estimated that the Cordilleran region contains 50,000,000,000 tons of mineable coal (mainly bituminous), but even these figures are probably much too small, for each year sees the discovery of a new field or the further extension of an old one.

The Cordilleran region has long been, and probably always will continue to be, the great gold-producing area of Canada. Much of the gold has come from placer deposits and, in all, the region has produced in the neighborhood of $220,000,000 in gold. Since the discovery of the first placer fields between 1855 and 1857, there has been a long series of discoveries of auriferous gravels, the most impor-

tant of recent years being that of the Klondike in the Yukon Territory. This northern field was discovered or announced in 1896 and in the following years took place a rush of gold seekers from all parts of the world. In 1900 the Klondike produced its maximum yield, amounting to $22,275,000. Of late years the total production of this and other relatively minor fields in the Yukon, has annually amounted to about $4,500,000, while the yield of the British Columbian placers has been somewhat less than $500,000.

The present annual gold yield from placer fields is almost equaled by the gold produced by lode mining. A considerable part of this is the product of free milling ores chiefly from one field in the neighborhood of Nelson, B.C. But about three-quarters of the total is from mines producing ores containing copper and some silver as well as gold.

An important element in the production of the Cordilleran region is the silver lead ores of a very large area, in southeastern British Columbia, that stretches eastward for many miles from the Arrow Lakes. One district, the Slocan district, produces annually above 6,000,000 pounds of lead and from 700,000 to 900,000 ounces of silver. Another district, the Fort Steele district, produces over 23,000,000 pounds of lead and nearly 600,000 ounces of silver. Some of the deposits in this general area are rich in zinc ores and a considerable, though not very large, production of zinc is furnished by the various districts. Practically all the lead produced in Canada comes from this Cordilleran area. The annual production has ranged during the last few years from above 60,000,000 pounds to less than 20,000,000 pounds, and the total production since 1893 amounts to above 650,000,000 pounds.

The *Arctic Archipelago* is the only one of all the major geological provinces of Canada that at present does not contribute to the annual mineral production. It embraces a very large region believed to be geologically not unlike the Interior Continental Plain. It is known to contain deposits of coal and presumably is lacking in metalliferous deposits.

In conclusion, it may again be pointed out and as the above brief review indicates, that the mineral industry of Canada as a whole is still in an initial stage. Only in the comparatively limited area extending eastward from the St. Lawrence Valley is the annual production in any way commensurate with the known mineral

resources of the country. And even in this eastern region the discoveries of recent years have indicated the existence of previously unsuspected classes of mineral deposits. Over nearly the whole of the vast area of Canada the mineral resources at present being developed are confined to very limited areas bordering the main routes of travel. Even within these circumscribed areas it is indisputably known that great stores of mineral wealth still lie untouched or undiscovered.

6. POPULATION OF CANADA BY PROVINCES AND TERRITORIES IN THE CENSUS YEARS 1871 TO 1911 AND OF NEWFOUNDLAND FROM 1891 TO 1919[1]

TABLE III

Provinces	1871	1881	1891	1901	1911	1921
Prince Ed. Island	94,021	108,891	109,078	103,259	93,728	88,615
Nova Scotia....	387,800	440,572	450,396	459,574	492,338	523,837
New Brunswick.	285,594	321,233	321,263	331,120	351,889	387,839
Quebec.........	1,191,516	1,359,027	1,488,535	1,648,898	2,003,232	2,349,067
Ontario........	1,620,851	1,926,922	2,114,321	2,182,947	2,523,274	2,929,054
Manitoba......	25,228	62,260	152,506	255,211	455,614	613,008
Saskatchewan...	....	....	....	91,279	492,432	761,390
Alberta........	....	....	....	73,022	374,663	581,995
British Columbia	36,247	49,459	98,173	178,657	392,480	523,363
Yukon Territory.	....	....	....	27,219	8,512	4,162
Northwest Ter..	48,000	56,446	98,967	20,129	18,481	6,684
TOTALS:						
Canada......	3,689,257	4,324,810	4,833,239	5,371,315	7,206,643	....
Newfoundland	....	....	197,934	217,037	238,670	*260,922

* Estimated in 1919. In addition, the population of Labrador (120,000 square miles), which is dependent on Newfoundland, was 3,647.

[1] *Canada Year Book*, 1918, p. 27.

CHAPTER II

RESOURCES AND INDUSTRIES OF CANADA

1. FARM LANDS IN CANADA[1]

To the question, What fraction of the total area of Canada is suited to agriculture? it is impossible from the nature of the case to return any exact reply, as the data do not exist from which definite conclusions can be drawn. Of the total land area in Canada, placed by the most recent measurements at 2,306,502,000 acres, 1,401,361,413 acres is the total land area of the nine provinces as at present constituted; the remaining area consists of the Northwest Territories (773,073,000 acres) and the Yukon territory (132,113,000 acres). The Northwest and Yukon territories may be omitted for the present, since no appreciable extent of land therein is likely to be devoted to agriculture before all the land within the provinces has been occupied. The following table . . . . takes no account of forests and swamp lands, which may ultimately be tilled, nor of northern districts of which the agricultural possibilities are at present unknown because the lands are unexplored and unsurveyed.

TABLE IV

AREAS OCCUPIED AND AREAS POSSIBLE OF OCCUPATION AS FARM LAND IN CANADA

PROVINCES	TOTAL LAND, ACRES	OCCUPIED AS FARM† LAND, 1911		ESTIMATE OF POSSIBLE FARM LAND	
		Acres	Per Cent of Total	Acres	Per Cent of Total
Prince Ed. Island.	1,397,991	1,202,354	86.01	1,258,000	90
Nova Scotia.....	13,483,671	5,260,455	38.01	8,090,000	60
New Brunswick..	17,863,266	4,537,999	25.44	10,718,000	60
Quebec........	442,153,287	15,613,267	3.53	44,215,000	10
Ontario.........	234,163,030	22,171,785	9.47	58,541,000	25
Manitoba*......	148,432,698	12,228,233	8.24	74,216,000	50
Saskatchewan*...	155,764,100	28,642,985	18.39	93,459,000	60
Alberta*........	161,872,000	17,751,899	10.96	105,217,000	65
British Columbia.	226,186,370	2,540,011	1.12	45,237,000	20
TOTAL........	1,401,316,413	109,948,988	7.84	440,951,000	31

* The provincial census of 1916 states that the amount of land occupied as farms in that year was 13,436,670 acres in Manitoba, 36,800,698 in Saskatchewan, and 23,062,769 in Alberta.

† Not necessarily in crops.

[1] *Canada Year Book,* 1914, pp. 207–8.

2. AREA, YIELD, AND VALUE OF PRINCIPAL FIELD CROPS IN CANADA, AVERAGE 1910–1913[1]

TABLE V

Crops	Area in Acres	Bushels per Acre	Total Yield, Bushels	Price per Bushel	Total* Value
Prince Edward Island					
Spring wheat	31,000	18.61	577,000	$0.98	$565,000
Oats	180,000	33.40	6,012,000	0.40	2,415,000
Barley	5,000	26.52	122,000	0.61	74,000
Buckwheat	3,000	26.79	71,000	0.62	44,000
Potatoes	32,000	179.94	5,686,000	0.30	1,723,000
Turnips, mangolds, etc.	8,000	471.05	3,580,000	0.21	760,000
Hay and clover	203,000	1.41	286,000	10.37	2,966,000
Nova Scotia					
Spring wheat	13,000	20.08	259,000	1.10	287,000
Oats	100,000	30.05	2,996,000	0.52	1,559,000
Barley	5,000	27.12	141,000	0.76	108,000
Buckwheat	11,000	23.98	259,000	0.65	169,000
Potatoes	31,000	191.40	6,010,000	0.48	2,872,000
Turnips, mangolds, etc.	11,000	415.39	4,694,000	0.33	1,537,000
Hay and clover	531,000	1.57	832,000	11.52	9,587,000
New Brunswick					
Spring wheat	13,000	18.64	248,000	1.02	253,000
Oats	200,000	28.85	5,769,000	0.50	2,872,000
Barley	3,000	26.79	71,000	0.61	43,000
Buckwheat	63,000	24.71	1,557,000	0.57	882,000
Potatoes	42,000	191.90	8,060,000	0.46	3,685,000
Turnips, mangolds, etc.	9,000	344.19	3,201,000	0.33	1,055,000
Hay and clover	610,000	1.30	790,000	9.21	7,274,000
Quebec					
Spring wheat	62,000	16.77	1,040,000	1.19	1,239,000
Oats	1,354,000	26.55	35,944,000	0.50	17,887,000
Barley	96,000	23.80	2,285,000	0.76	1,741,000
Rye	11,000	15.08	169,000	0.99	168,000
Peas	30,000	15.40	462,000	1.65	760,000
Beans	5,000	18.23	93,000	2.19	204,000
Buckwheat	116,000	23.00	2,668,000	0.72	1,924,000
Mixed grains	103,000	26.13	2,692,000	0.66	1,778,000
Corn for husking	20,000	29.65	587,000	0.99	578,000
Potatoes	120,000	141.17	16,940,000	0.48	8,104,000
Turnips, mangolds, etc.	13,000	304.37	3,835,000	0.34	1,317,000
Hay and clover	3,160,000	1.49	4,712,000	10.20	49,055,000
Fodder corn	37,000	8.28	303,000	4.66	1,412,000
Ontario					
Fall wheat	767,000	22.21	17,036,000	0.88	14,967,000
All wheat	886,000	21.70	19,225,000	0.88	16,900,000
Oats	2,819,000	33.35	94,005,000	0.40	37,490,000
Barley	505,000	28.45	14,365,000	0.60	8,608,000
Rye	92,000	16.96	1,560,000	0.73	1,131,000

* Yield per acre, total yield, and price for hay and clover, fodder corn, and alfalfa are in tons.

[1] *Canada Year Book*, 1914, pp. 143–63. The area, total yield, and total value are expressed in round numbers.

TABLE V—*Continued*

Crops	Area in Acres	Bushels per Acre	Total Yield, Bushels	Price per Bushel	Total* Value
Ontario—Continued					
Peas	249,000	15.23	3,793,000	$0.98	$3,706,000
Beans	43,000	17.86	768,000	1.89	1,448,000
Buckwheat	186,000	22.19	4,128,000	0.56	2,327,000
Flax	8,000	15.23	128,000	1.62	207,000
Corn for husking	278,000	58.32	16,214,000	0.60	9,755,000
Potatoes	156,000	118.80	18,533,000	0.62	11,486,000
Turnips, mangolds, etc.	131,000	361.63	47,373,000	0.20	9,419,000
Hay and clover	3,328,000	1.39	4,622,000	11.89	54,969,000
Fodder corn	249,000	9.51	2,369,000	4.71	11,149,000
Sugar beets	17,000	9.82	167,000	5.90	986,000
Alfalfa	66,000	2.35	155,000	11.30	1,751,000
Manitoba					
All wheat	2,875,000	18.54	53,291,000	0.70	37,346,000
Oats	1,316,000	38.82	51,082,000	0.30	15,131,000
Barley	460,000	28.04	12,897,000	0.40	5,108,000
Rye	4,000	19.32	85,000	0.64	54,000
Flax	67,000	11.99	803,000	1.36	1,091,000
Potatoes	26,000	186.13	4,914,000	0.40	1,965,000
Turnips, mangolds, etc.	4,000	308.29	1,079,000	0.39	425,000
Hay and clover	151,000	1.46	220,000	9.34	2,054,000
Fodder corn	9,000	7.25	66,000	9.32	615,000
Alfalfa	3,000	2.50	7,000	10.57	74,000
Saskatchewan					
All wheat	5,197,000	19.46	101,143,000	0.61	61,799,000
Oats	2,383,000	41.77	99,541,000	0.26	25,963,000
Barley	257,000	30.88	7,935,000	0.36	2,866,000
Rye	2,000	22.27	49,000	0.49	24,000
Flax	1,089,000	11.51	12,544,000	1.09	13,728,000
Potatoes	29,000	173.41	5,029,000	0.48	2,392,000
Turnips, mangolds, etc.	11,000	266.32	2,903,000	0.45	1,296,000
Hay and clover	50,000	1.60	80,000	8.34	667,000
Alberta					
All wheat	1,405,000	20.34	28,584,000	0.60	17,067,000
Oats	1,276,000	41.99	53,576,000	0.26	13,771,000
Barley	167,000	28.96	4,837,000	0.35	1,683,000
Rye	13,000	24.62	320,000	0.54	174,000
Flax	94,000	10.74	1,010,000	1.09	1,104,000
Potatoes	24,000	177.83	4,268,000	0.43	1,846,000
Turnips, mangolds, etc.	4,000	262.75	1,051,000	0.45	470,000
Hay and clover	165,000	1.45	240,000	10.60	2,543,000
Alfalfa	7,000	2.64	19,000	10.47	199,000
British Columbia					
All wheat	12,000	28.27	345,000	1.00	346,000
Oats	43,000	53.95	2,320,000	0.56	1,300,000
Barley	2,000	38.75	93,000	0.70	65,000
Potatoes	15,000	215.79	3,129,000	0.61	1,913,000
Turnips, mangolds, etc.	3,000	487.42	1,511,000	0.53	806,000
Hay and clover	138,000	2.07	285,000	17.65	5,032,000
Alfalfa	6,000	4.39	25,000	15.04	376,000

*Yield per acre, total yield, and price for hay and clover, fodder corn and alfalfa are in tons.

3. NUMBER OF FARM LIVE STOCK BY PROVINCES IN 1919[1]

TABLE VI

Province	Horses	Milch Cows	Other Cattle	Sheep	Swine
Prince Edward Island	34,576	45,662	79,815	114,955	49,510
Nova Scotia	65,589	162,230	243,831	261,529	69,982
New Brunswick	77,828	153,058	211,964	212,745	104,939
Quebec	463,902	1,056,347	1,213,297	1,007,425	935,425
Ontario	732,977	1,141,016	1,786,175	1,101,740	1,695,487
Manitoba	379,356	227,872	553,899	167,170	261,542
Saskatchewan	1,078,452	374,062	1,005,501	146,911	432,367
Alberta	800,380	336,596	1,247,448	364,498	445,858
British Columbia	43,717	51,594	194,644	44,985	44,960
Canada	3,667,369	3,548,437	6,536,574	3,421,958	4,040,070

4. PRODUCTION AND VALUE OF CREAMERY BUTTER AND FACTORY CHEESE IN CANADA BY PROVINCES IN 1917[2]

TABLE VII

Province	Butter		Cheese	
	Pound	Value	Pound	Value
Prince Edward Island	597,271	$ 239,940	2,234,985	$ 466,317
Nova Scotia	1,746,662	711,652	67,497	14,269
New Brunswick	565,699	233,686	1,244,106	257,645
Quebec	34,392,560	13,689,310	67,835,017	14,162,213
Ontario	28,714,352	11,219,029	121,173,086	25,771,944
Manitoba	7,050,921	2,595,472	1,003,646	199,036
Saskatchewan	4,098,187	1,528,935	....	....
Alberta	8,943,971	3,414,541	1,274,905	280,185
British Columbia	1,294,743	594,623	71,094	18,954
Canada	87,404,366	34,227,188	194,904,336	41,170,563

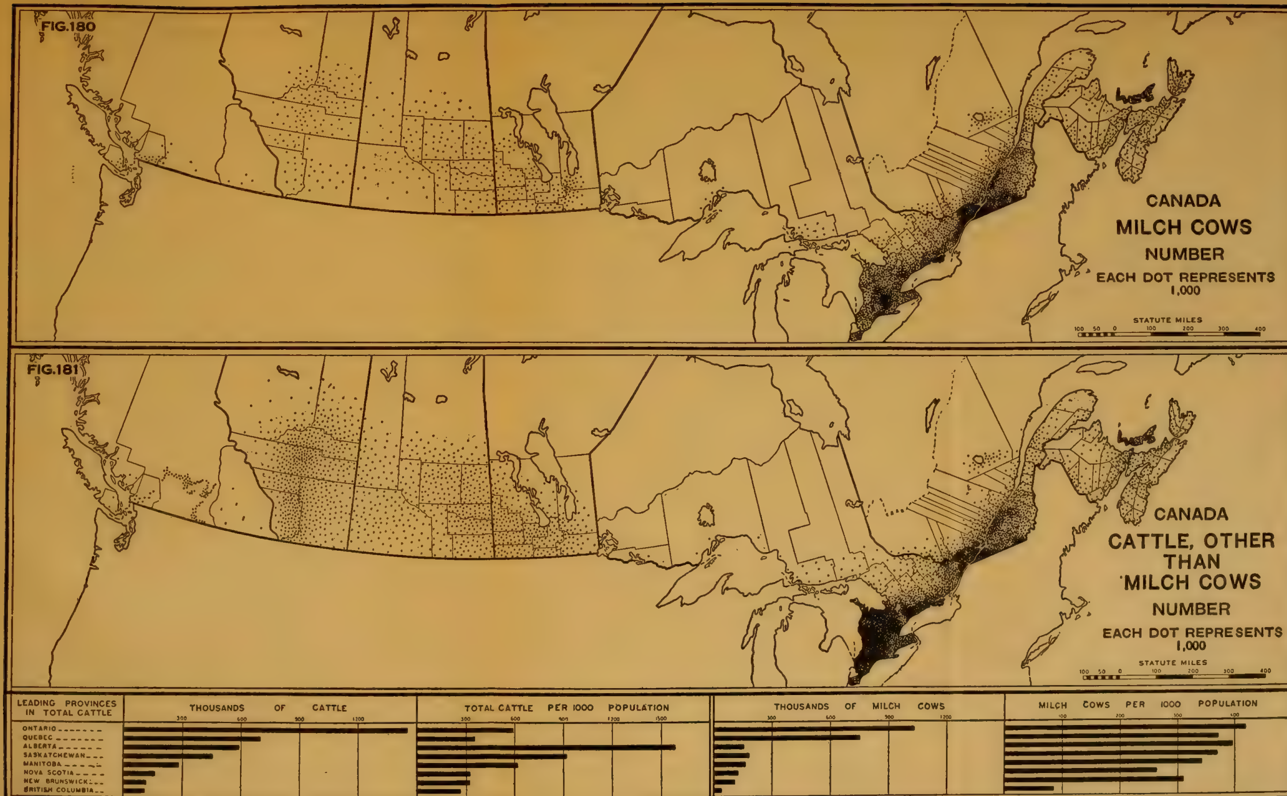
5. THE DISTRIBUTION OF CATTLE IN CANADA[3]

Cattle are more widely distributed in Canada than other livestock and probably than any one farm crop. The distribution of both dairy cows and other cattle is shown on map facing this page.

[1] *Canada Year Book*, 1919, pp. 193–95.

[2] *Ibid.*, 1918, pp. 202–3.

[3] Text by Charles C. Colby; map as indicated.



MAP 1.—Reproduced from V. C. Finch and O. E. Baker, *Geography of the World's Agriculture*, Office of Farm Management, United States Department of Agriculture, 1917, p. 126

The outstanding position of the provinces of Ontario and Quebec in both phases of the cattle industry is demonstrated by the graphs which accompany the maps and by Tables VI and VII. As the maps indicate, cattle raising in these provinces is confined to the St. Lawrence Lowlands and the adjacent uplands, the only exceptions being a small development of the dairy business about the mining camps north of Georgian Bay and near the twin ports, Port Arthur and Fort William on Lake Superior. In these lowlands an abundant summer rainfall and a relatively cool growing season make it possible to maintain excellent pastures and to produce large quantities of cereals, hay, and clover, and fodder crops. In addition the dairy industry has the advantage of an active local market in the industrial and commercial cities of the St. Lawrence Valley. Years of experience and experimentation in the manufacture of butter and cheese have lead to an organization of this industry which insures products of such high quality that they compete successfully in British and American markets. The large number of cattle other than dairy cows raised in Ontario Peninsula between Lake Huron and Lake Erie is due to the position of this peninsula at the northern margin of the corn belt. Its corn crop is large enough to stimulate the feeding of beef cattle and to make it the principal hog-raising district of Canada.

As cattle or dairy cows are raised on most Canadian farms and ranches, these maps approximately indicate the occupied areas of the country. They show that few cattle are raised in the relatively unsettled hilly crystalling uplands of eastern Nova Scotia, central and western New Brunswick, and the Gaspé Peninsula and emphasize the vast stretch of unoccupied territory north of Lake Superior and the Rainy River. Thus, in Canada, the middle portion of the country, corresponding in position to the fertile plains of the corn belt in the United States, is at the present time a wilderness. As this area has the topography and soil characteristic of the Laurentian Plateau, most of it is not suited to agriculture, so that its settlement will depend upon its forest and mineral resources.

While cattle are raised throughout the occupied portions of the Prairie Provinces, the industry is most significant in the plains contiguous to the Rocky Mountains where the chinook makes winter-grazing possible, and the irrigated districts provide fodder to supplement the pastures.

6. PRODUCTS OF THE FORESTS OF CANADA IN 1918[1]

TABLE VIII

QUANTITIES AND VALUES OF THE CUT OF LUMBER, SHINGLES, AND LATH BY PROVINCES IN 1918

Province	Lumber		Shingles		Lath	
	Quantity M.ft.b.m.*	Value	Quantity M.ft.b.m.*	Value	Quantity M.ft.b.m.*	Value
Ontario	1,110,062	$34,168,754	52,393	$ 183,328	148,999	$ 506,516
British Columbia	1,157,636	28,351,207	2,162,184	6,641,174	49,741	179,041
Quebec	841,084	20,916,604	249,160	775,058	78,633	214,711
New Brunswick	439,625	12,189,312	170,486	512,812	117,521	328,554
Nova Scotia	176,332	4,089,039	19,138	49,633	16,459	41,630
Saskatchewan	75,835	2,122,307	....	....	17,244	73,490
Manitoba	54,047	1,240,052	....	....	8,698	22,764
Alberta	22,388	473,694	212	577	....	....
Prince Edward Island	6,393	136,336	8,948	21,466	805	2,901
Yukon	229	10,315	....	....	....	....
TOTAL	3,883,631	103,697,620	2,662,521	8,184,448	438,100	1,369,616

* M. ft. b. m. signifies 1,000 feet board measure.

TABLE IX

QUANTITIES AND VALUES OF WOOD USED IN THE MANUFACTURE OF PULP AND THE AMOUNT OF PULP AND PAPER PRODUCED BY PROVINCES IN 1918

Province	Wood Used, Cords	Value	Pulp Produced, Tons	Paper Produced. Tons
Quebec	1,085,478	$11,061,191	802,030	419,980
Ontario	784,691	10,395,717	505,366	425,228
New Brunswick	110,133	920,854	66,619	....
Nova Scotia	11,668	73,816	10,017	....
British Columbia	218,774	2,434,897	173,161	122,516
TOTAL	2,210,744	24,886,475	1,557,193	967,724

[1] *Canada Year Book*, 1919, pp. 239, 241, 243.

7. THE MINERAL PRODUCTS OF CANADA[1]

TABLE X

QUANTITIES AND VALUES OF MINERALS PRODUCED IN CANADA, 1916 AND 1917

Description	Tons*		Values	
	1916	1917†	1916	1917†
Metallic				
Copper, lb.	117,150,028	108,860,358	$31,867,150	$29,588,254
Gold, oz.	930,492	747,366	19,234,976	15,449,426
Pig iron, ton	115,691	46,022	1,328,605	768,783
Lead, lb.	41,497,615	32,072,269	3,532,692	3,571,889
Nickel, lb.	82,958,564	84,470,970	29,035,498	33,778,388
Silver, oz.	25,459,741	22,150,680	16,717,121	18,034,419
Zinc, lb.	23,364,760	31,227,351	2,991,623	2,779,547
Other metallic products	....	....	1,611,700	2,660,046
Total Metallic	....	....	106,319,365	106,630,752
Non-Metallic				
Asbestos and asbestic, ton	154,149	153,781	5,228,869	7,234,077
Coal, ton	14,483,395	14,015,588	38,817,481	47,643,646
Gypsum, ton	342,915	339,418	738,593	887,170
Natural gas, M. cu. ft.	25,467,458	26,465,686	3,958,029	5,003,342
Petroleum, brl.	198,123	205,332	392,284	478,937
Pyrites, ton	309,251	403,243	1,084,095	1,586,091
Salt, ton	132,903	138,909	717,653	1,047,792
Cement, brl.	5,369,560	4,768,488	6,547,728	7,699,521
Clay products	....	....	4,120,805	4,603,755
Lime, bu.	5,493,250	6,338,212	1,091,463	1,517,918
Sand and gravel, ton	8,156,207	7,157,279	1,838,320	1,908,773
Stone:				
Granite	....	....	1,247,267	613,588
Limestone	....	....	2,224,091	2,291,692
Marble and sandstone	....	....	265,054	316,142
Misc. non-metallic	....	....	2,610,437	3,808,620
Total non-metallic	....	....	70,882,169	86,641,064
GRAND TOTAL	....	....	177,201,534	193,271,816

* The ton is the short ton of 2,000 lb. † Subject to revision.

[1] *Canada Year Book*, 1918, pp. 260, 263–67.

TABLE XI

VALUE OF MINERALS PRODUCED IN CANADA BY PROVINCES IN THE CALENDAR YEARS 1916 AND 1919

Province	1916		1919*	
	Value	Per Cent of Total	Value	Per Cent of Total
Nova Scotia	$20,042,262	11.31	$23,213,751	13.4
New Brunswick	1,118,187	0.63	1,675,606	1.0
Quebec	14,406,598	8.13	21,341,829	12.3
Ontario	80,461.323	45.41	65,842,826	38.0
Manitoba	1,823 576	1.03	2,846,565	1.7
Saskatchewan	590,473	0.33	1,118,055	0.7
Alberta	13,297,543	7.50	20,815,049	12.0
British Columbia	39,969,962	22.56	34,258,267	19.8
Yukon Territory	5,491,610	3.10	1,963,965	1.1
TOTAL	177,201,534	100.00	173,075,913†	100.0

* Subject to revision.

8. WATER POWERS OF CANADA[1]

Canada is fortunate in the extent and location of her water-powers. During the last twenty-five years nearly 1,800,000 water horse-power has been developed and employed. Table XII, a statement compiled from recent data, shows the available and developed water-powers of the principal European countries, as compared with those of the United States and Canada. It will be seen from this statement that Canada occupies a unique position as regards both potential and developed water-power. The present per capita power developed in Canada is larger than all other countries except Norway. It is the same with respect to known undeveloped water-power. No country enjoys to a greater degree the benefits of cheap dependable hydro-power, and no country has had these benefits more universally applied for municipal, industrial, and domestic use. That Canada is one of the great water-power countries of the world is due largely to (1) the nature and extent of water resources—abundance and seasonable distribution of rainfall; the regimen of the rivers—upper waters

[1] Adapted by permission from J. B. Challies, "Water Powers of Canada," *Canada Year Book*, 1918, p. 281–83, 1919, p. 287. Mr. Challies is Superintendent, Dominion Water Power Branch, Department of the Interior, Canada.

well forested with large lakes suitable for regulation—rivers flowing through valleys with well concentrated falls; (2) the fortunate location of the waterfalls with respect to existing commercial centers and related raw materials; (3) the action of Dominion and Provincial governments in having the water-powers thoroughly investigated and intelligently administered; (4) the foresight of the capitalist, and the professional skill of the engineer, in water-power development and use; (5) the almost universal adaptation of electrical energy for municipal, industrial, and domestic purposes.

TABLE XII

WATER POWERS OF EUROPEAN COUNTRIES AND OF THE UNITED STATES AND CANADA

Country	Area in sq. miles	Population	Horse-power Available	Horse-power Developed
U.S.A.	2,973,890	98,783,300	28,100,000	7,000,000
*Canada	2,000,000	8,033,500	19,554,000	2,305,000
Austria-Hungary	261,260	51,173,800	6,460,000	566,000
France	207,500	39,601,500	5,587,000	1,200,000
Germany	208,800	64,926,000	1,425,000	618,000
Italy	91,400	28,601,600	7,000,000	1,500,000
Norway	124,130	2,391,780	5,500,000	1,300,000
Spain	190,401	19,588,700	5,000,000	440,000
Sweden	172,960	5,522,400	6,700,000	1,105,000
Switzerland	15,976	3,781,500	2,000,000	511,000

*Excludes the northern area improbable of immediate development.

Within economic transmission range of practically every important city from the Atlantic to the Pacific, except those in the central western prairies, there are clustered water-power sites, which will meet the probable demands for hydro-power for generations. Table XIII indicates with reasonable accuracy the provincial distribution of the developed and undeveloped water-powers within the settled portions of the Dominion.

In general, the use of Canadian water-powers may be distributed as (*a*) for municipal purposes; (*b*) for pulp and paper; and (*c*) for electric, chemical, and similar processes. For municipal, including domestic and ordinary industrial purposes, about 78 per cent of the total has been developed, or 1,348,490 horse-power. For these uses

further requirements will probably be met for some years by additional installations at, and increased storage for, existing plants. In certain centers, however, as for instance the Niagara power zone, growing requirements can only be met by new water-power development.

TABLE XIII

DISTRIBUTION OF DEVELOPED WATER-POWER IN CANADA BY PROVINCES AND BY USE OF POWER, JANUARY 1, 1919, AND ESTIMATED WATER-POWER AVAILABLE*

Province	Water Power Developed, Horse Power				
	Central† Electric Stations	Pulp‡ and Paper	Other Industries	Total	Water-power Available, Horse-power
British Columbia	221,625	46,450	44,348	312,423	3,000,000
Alberta	32,580	....	300	32,880	466,000
Saskatchewan	....	....	....	....	567,000
Manitoba	64,100	....	12,072	76,172	3,218,000
Ontario	791,163	133,932	59,945	985,060	5,800,000
Quebec	597,601	155,512	89,648	842,761	6,000,000
New Brunswick	6,878	2,800	5,191	14,869	300,000
Nova Scotia	3,354	13,500	9,170	26,024	100,000
Prince Edward Island	170	....	1,559	1,729	3,000
Yukon	10,000	....	3,392	13,392	100,000
Northwest Territories	....	....	....	....	....
TOTAL	1,727,471	352,214	225,625	2,305,310	19,554,000§

* Census of Industry of Canada, 1917, Sessional Paper No. 17*e*, 9 George V, 27.

† Includes only hydro-electric stations which develop power for sale.

‡ Includes only power owned by pulp and paper companies. A further 100,000 horse-power or upward is purchased by pulp and paper companies from central electric stations, making the total hydro-power utilized in the pulp and paper industry some 450,000 horse-power. If this 100,000 horse-power is added to column 3 it should be subtracted from column 2 to maintain the correct tabular totals.

§ On account of the absence of data about the water-powers of the northern territories and of the unsettled sections in the northern part of the various provinces and in regard to the minor powers in the settled sections of these provinces, this estimate of the total water-power available in Canada must be regarded as a rough approximation

For pulp and paper, about 15 per cent of the total had been developed, or 352,214 horse-power. Further requirements can probably be met for some time by additional installations to present plants, although the growth of this industry will necessitate the development of new water-powers in different parts of the Dominion. There are now 54 pulp and paper plants scattered throughout Canada, and

several new plants have been under serious contemplation, some of which would be in use now had it not been for the difficulty of financing due to war conditions. On account of the isolated nature of the industry—away from commercial centers—power requirements for pulp and paper need not conflict with other demands upon hydropower.

For the electro-chemical and similar processes, about 8 per cent of the total has been developed, or 140,000 horse-power. While the United States have achieved almost a world-supremacy in electrochemical processes, the industry in Canada is of very recent growth. It has, however, expanded at an enormous rate, entailing recent extensive additional installations in present plants, and it will require in the near future the development of additional water-power sites. Propinquity to the United States and abundance of essential raw material will compel the migration to the Dominion of many new electro-chemical plants of importance and value. The products of the electro-chemical industry are extremely diversified. They include aluminium. silicon, calcium-carbide, cyanamid, ferro-alloys, graphite, carborundum, chlorine, etc., many of which are indispensable in arts and manufactures. Without aluminium the modern high-speed scout airplane could not exist; without electro-chemical abrasives and ferro-alloys manufacturing processes would be lengthened many fold. Industrial supremacy in time of peace is dependent upon these products to a very considerable extent.

One of the most important electro-chemical processes is the fixation of nitrogen; about 30,000 horse-power is used for this purpose at Niagara by the American Cyanamid Company, and, while other plants of this kind have so far not been put into operation commercially in this country, they have been seriously contemplated, and await only a sufficient source of low-price power for realization. The electro-metallurgical industry is in its infancy, but promises great expansion, especially in the production of nicu-steel in Canada. During the last two years there has been rapid growth in the use of electric furnaces for the production of the highest grades of steel.

By proper foresight the demand for hydro-power for these industries need not conflict with other demands, as for instance, those for municipal, domestic, and ordinary industrial uses. As shown in Table XIII the total developed power is about 2,305,310 horse-power.

9. MANUFACTURES OF CANADA

TABLE XIV

THE LEADING MANUFACTURES OF CANADA IN 1917[1]

(000,000 omitted except in first and third columns)

	No. of Establishments	Capital	No. of Employees on Wages	Wages Paid	Cost of Materials	Value* of Products
I. *Food products*	8,009	$299	49,062	$35	$565	$755
Flour and gristmill products	1,098	73	5,428	4	184	224
Slaughtering and meat packing	69	68	6,879	6	117	153
Butter and cheese	3,399	16	3,410	4	72	86
Bread, biscuits, and confectionery	2,026	36	16,241	11	44	77
Sugar refined	8	32	2,252	2	53	73
Slaughtering, not including meat packing	10	17	1,226	1	39	53
Fish, preserved	982	20	5,509	3	18	27
II. *Textiles*	4,112	203	78,906	43	142	265
Cottons	26	40	15,053	7	20	40
Hosiery and knit goods	102	29	11,080	6	19	34
Clothing, women's factory	172	18	11,299	7	16	32
Clothing, men's factory	170	23	8,599	5	16	31
III. *Iron and steel products*	1,049	307	70,071	69	205	400
Rolling mills and steel furnaces	40	92	15,021	18	109	171
Foundry and machine-shop products	629	70	21,535	19	24	67
Iron and steel products	76	41	11,226	10	32	59
Boilers and engines	58	24	7,646	8	8	26
Iron, pig	10	33	1,241	2	11	26
IV. *Timber and lumber and their re-manufactures*	4,463	290	92,139	59	87	226
Log products, sawmill	2,879	149	54,676	34	41	116
Lumber products	753	38	8,260	5	15	29
Woodpulp, chemical and mechanical	34	36	5,661	5	8	24
V. *Leather and its finished products*	1,249	76	18,450	12	61	105
Boots and shoes	185	31	11,338	7	27	49
Leather, tanned and curried	136	31	3,774	3	27	41
VI. *Paper and Printing*	1,819	224	40,510	31	51	148
Pulp and paper	23	142	14,153	12	22	62
Printing and publishing	916	31	9,692	8	7	31
VII. *Liquors and beverages*	433	48	4,325	3	13	30
VIII. *Chemicals and allied products*	333	118	14,953	12	66	134
Explosives	9	16	3,228	3	14	26
Petroleum	6	16	2,620	3	14	30
IX. *Clay, glass, and stone products*	913	79	11,079	9	5	32
X. *Metals and metal products other than iron and steel*	2,311	123	26,280	23	91	172
Smelting	17	55	5,799	7	36	69
Plumbing and tinsmithing	1,656	27	9,155	6	19	35
Brass castings	76	14	3,642	3	16	24
XI. *Tobacco and its manufactures*	176	27	8,940	4	19	47
Tobacco, cigars, and cigarettes	146	18	6,871	3	15	32
XII. *Vehicles for land and air transportation*	970	220	47,817	43	102	197
Cars and car works	13	98	19,093	18	39	79
Automobiles	11	28	5,015	5	36	54
Car repairs	125	69	15,982	14	15	37
XIII. *Vessels for water transportation*	201	43	12,289	13	13	37
Ships and ship repairs	70	42	11,370	12	13	35
XIV. *Miscellaneous industries*	2,378	680	94,534	74	155	386
Ammunition	122	66	37,490	34	43	113
Electric light and power	666	356	5,501	4	....	45
Electrical apparatus and supplies	75	39	8,234	6	20	40
Rubber and elastic goods	22	22	5,227	4	17	34
Agricultural implements	90	70	9,562	8	16	32
XV. *Hand trades*	5,976	48	31,950	25	30	81
Housebuilding	900	25	17,714	16	23	55

* Only manufactures which had a value of $25,000,000 or more in 1917 are listed.

[1] Compiled from *Canada Year Book*, 1919, 277–83.

TABLE XV

STATISTICS OF MANUFACTURES BY PROVINCES FOR 1917[1]

(000,000 omitted from columns 2, 4, 5, and 6)

Provinces	No. of Establishments	Capital	No. of Employees	Salaries and Wages	Cost of Materials	Value of Products
Canada.........	34,392	$2,787	674,910	$550	$1,606	$3,016
Prince Ed. I...	534	3	1,923	1	3	6
Nova Scotia..	2,147	137	31,398	24	110	176
N. Brunswick.	1,423	66	21,363	14	33	62
Quebec.......	10,042	823	211,018	158	403	831
Ontario......	14.381	1,336	326,635	278	823	1,534
Manitoba....	1,329	101	22,670	20	73	123
Saskatchewan.	1,436	33	8,210	7	23	41
Alberta......	1,317	63	11,524	10	44	72
British Col....	1,772	221	40,098	38	92	171
Yukon.......	11	4	71	....	....	....

10. TOTAL VALUE OF FISHERIES BY PROVINCES IN THE FISCAL YEARS 1913-1917[2]

TABLE XVI

Province	1913	1914	1915	1916	1917
Prince Edward Island......	$1,379,905	$1,280,447	$1,261,666	$ 933,682	$1,344,179
Nova Scotia.............	7,384,055	8,297,626	7,730,191	9,166,851	10,092,902
New Brunswick...........	4,264,054	4,308,707	4,940,083	4,737,145	5,656,859
Quebec..................	1,988,241	1,850,427	1,924,430	2,076,851	2,991,624
Ontario.................	2,842,878	2,674,685	2.755,291	3,341,182	2,658,993
Manitoba................	800,149	606,272	849,422	742,925	1,390,002
Saskatchewan............	111,839	148,602	132,017	165,888	231,946
Alberta.................	51,616	81,319	86,720	94,134	144,317
British Columbia.........	14,455,488	13,891,398	11,515,086	14,538,320	14,637,346
Yukon...................	111,239	68,265	69,725	63.730	60,210
Total for Canada.......	33,389,464	33,207,748	31,264,631	35,860,708	39,208,378

Production and Value of Fisheries. In comparing the results of one season with another it must not be forgotten that the volume of production is affected by certain natural conditions which differ greatly from year to year. For instance, every fourth year there occurs on the Fraser River a big run of salmon. In the following

[1] *Canada Year Book*, 1919, p. 275.

[2] *Ibid.*, 1918, pp. 255-58.

years the run gradually diminishes till it reaches its poorest stage in the year preceding the next big run. The masses of herring and mackerel that visit Canadian shores vary in volume annually—the latter especially being extremely erratic in their movements. The hook and-line fisheries for cod, haddock, hake, halibut, etc., are dependent on a supply of herring for bait, and a scarcity or abundance of this bait fish immensely affects the output of the line fishermen. Dogfish are more numerous in some seasons than in others, and destroy edible fish and gear to such an extent as to stop operations at times. Lastly the state of the weather, by limiting the number of fishing days or permitting operations on the greatest possible number of days in the course of the season, affects the production of all kinds of fish perhaps more than any other natural agent. The season of 1916 was adversely affected by several of these conditions. The poorest salmon year in the cycle of four on the Fraser River occurred; there was an abnormal amount of unfavourable foggy weather on the Atlantic coast; the spring herring fishery in the Gulf of St. Lawrence was greatly curtailed as a result of ice remaining on the coast till a late date; and the summer and fall herring fishery all over the Atlantic coast was a very poor one.

11. CANADIAN RAILWAY DEVELOPMENT[1]

The factor of greatest importance in the opening up of a new country is its railways. Canada is pre-eminently the new country of the twentieth century, and it is interesting to see in just what way the railways are furthering the tremendous development of the industries, and the colonization of unsettled territory.

The striking feature of the great railway expansion is the part played by the government in stimulating company enterprise, and in building government railroads where private companies do not feel justified in taking the risk. Up to the end of June, 1911, the Dominion government had expended for the construction of government railways a total of $261,414,695 and had granted subsidies to private railways amounting to $148,217,072, and land grants along their right-of-ways totaling 32,004,474 acres. The subsidies granted

[1] Adapted from John J. O'Neill, "Canadian Railway Development," *Journal of Geography*, April, 1913, pp. 265–67.

by the separate provinces up to the same date totaled $35,919,360, with land grants of 32,251,943 acres, making a grand total of governmental aid to private companies of over $184,000,000 and 55,256,417 acres of land.

The five great railways in Canada are: (1) The Canadian Pacific Railway; (2) The Grand Trunk Railway; (3) The Grand Trunk Pacific Railway; (4) The Canadian Northern Railway; (5) The Intercolonial Railway.[1]

The first and third of these are transcontinental lines, and number four may almost be considered such. The Intercolonial and the eastern division of the Grand Trunk Pacific are the property of the Dominion government; the others are owned by private companies. The Canadian Pacific Railway has the unique distinction of being the longest single railroad on the American continent; in 1911 its length was over 10,200 miles, and it forms a continuous Canadian system from the Atlantic to the Pacific. Not only does this railway dominate land traffic but it maintains fleets of steamers on the Great Lakes and on both oceans, plying between Montreal and Liverpool, and between Vancouver and Yokohama, Japan. It maintains its own hotels, one of which is to be found in every large city and in numerous resorts en route.

The Grand Trunk system in Canada operated 3,095 miles of railroad in 1911. This railway is not purely Canadian but has a large part of its system in the United States; its eastern terminus is Portland, Maine, and it extends west to Chicago. It does not maintain a system of hotels but has just opened one valued at $2,000,000 in Ottawa.

In 1903 this company made an agreement with the Federal government by which it undertook to build the western division of the Grand Trunk Pacific; and upon completion of the road the company will lease the eastern division and operate the whole system.

The Canadian Northern is one of the most active railways in the country; in 1911 there were 3,688 miles of railroad in operation, and it is rapidly connecting separate stretches of road so that in the near future this railroad also will be transcontinental. It is constantly

[1] In 1918 the miles operated by these railways were: Canadian Pacific, 13,295; Canadian Northern, 9,320; Grand Trunk, 3,567; Grand Trunk Pacific, 2,714; Intercolonial, 1,592.

extending its lines, and one of the big feats in construction at present is the driving of a tunnel through Mount Royal, at Montreal, to afford an entry to the heart of the city from the north.

The Intercolonial Railway is owned and operated by the Dominion government. It extends from Halifax, Nova Scotia, to Montreal, Quebec, and is over 1,450 miles in length. It was built in fulfilment of one of the clauses of the Confederation of the Provinces.

The Grand Trunk Pacific Railway is treated last because it is the newest, and is being built under peculiar conditions. In 1903 the Dominion government entered into an agreement with the Grand Trunk Railway by which a transcontinental railway was to be built wholly on Canadian territory. The essentials of this contract were that the government should construct the eastern section of the road, i.e., that part from Moncton, New Brunswick, on the Atlantic coast, west to Winnipeg, Manitoba, and that the Grand Trunk Railway should build at its own expense the western section extending from Winnipeg to Port Simpson or Prince Rupert on the Pacific coast. The road was to be completed in 1913. The length of the eastern division is 1,805 miles, and over 68.5 per cent of the whole work was completed by June 30, 1911; the total expenditure up to this date was $95,423,085. The western division is divided into two sections, a prairie section and a mountain section. It has a total length of 1,750 miles and traverses the most fertile belt of the western prairie provinces and of British Columbia, thus opening up for settlement a vast area of the finest wheat land in the world. A large part of both divisions is already under operation, and the whole line will be finished within a year or two. This system is already operating a line of steamships in the Pacific coastal trade.

The government is going ahead with a new railway, the Hudson Bay Railway, which will extend from Winnipeg to Port Nelson on the west side of Hudson Bay, and possibly from Montreal to a port on east side of the same bay, thus opening up a great stretch of new territory, and providing another outlet for the great wheat crops of the West.

12. STEAM RAILWAY MILEAGE BY PROVINCES, 1911–1917[1]

TABLE XVII

Provinces	1911	1913	1915	1917
Ontario	8,322	9,000	10,702	11,049
Quebec	3,882	3,986	4,677	4,734
Manitoba	3,466	3,933	4,498	4,194
Saskatchewan	3,121	4,651	5,327	6,124
Alberta	1,494	2,212	3,174	4,444
British Columbia	1,842	1,951	3,100	3,885
New Brunswick	1,548	1,545	1,962	1,959
Nova Scotia	1,354	1,360	1,367	1,422
Prince Edward Island	269	279	275	278
Yukon	102	102	102	102
In United States*	....	225	398	413
Canada	25,400	29,304	35,582	38,604

* The mileage shown in the United States relates entirely to lines which cross American territory in passing from one point in Canada to another; such lines, although not heretofore included in Canadian mileage, are operated wholly for the purposes of Canadian traffic. There is a large additional mileage in the United States, which is owned and operated by Canadian Railways, but of which no account is taken in these statistics.

[1] *Canada Year Book*, 1918, p. 407.

CHAPTER III

MARITIME CANADA AND NEWFOUNDLAND

1. THE APPALACHIAN REGION[1]

The *Appalachian region* of Canada may be defined as including the territory lying east of a line running northeast from the foot of Lake Champlain on the Vermont border, to the city of Quebec and thence down the St. Lawrence Valley, that is, it contains most of the Province of Quebec lying east of the St. Lawrence, together with the Maritime Provinces of New Brunswick, Prince Edward Island, and Nova Scotia. The country is part of a mountainous belt, the Appalachian Mountain system, that, commencing not far from the Gulf of Mexico, continues northeastward through the eastern portion of the continent to the Gulf of St. Lawrence, beyond which it reappears in the island of Newfoundland. Throughout this belt the strata are frequently highly folded and faulted, and evidence of igneous activity is not wanting; while within it, in Canada as elsewhere, are many valuable mineral deposits, including the asbestos deposits of southeastern Quebec, the most noted in the world, the coal and gold fields of Nova Scotia, as well as bodies of iron, copper, and various other ores.

The Appalachian Mountain system, throughout its entire course of 1,700 miles within the limits of the continental land, preserves a general southwest and northeast trend. In northern New York, the New England states, and Eastern Canada, the mountain system is irregular in structure. In Eastern Canada, the Appalachian system, regarded as a mountainous belt, is, strictly speaking, represented only by the elevated tracts of eastern Quebec and northern New Brunswick. Elsewhere, over the greater part of the Maritime Provinces, the Appalachian character is mainly represented by the general trend of the major hills and of the large indentations of the sea, and by the general geological structure of the country as a whole.

[1] Adapted from G. A. Young, *A Descriptive Sketch of the Geology and Economic Minerals of Canada*, Department of Mines, Geological Survey Branch No. 1085, pp. 30–32.

In the eastern townships of southeastern Quebec, the Green Mountains of Vermont are continued northeastward by the Notre Dame Mountains, that approach the St. Lawrence below Quebec, and from there, bordering the estuary of the river, continue with increasing altitudes into and through the Gaspé Peninsula, where they are known as the Shickshocks. In the eastern townships the Notre Dame Mountains are represented by three rudely parallel ridges, that, passing eastward, have progressively higher average elevations, and finally, over considerable areas, rise above 2,000 feet.

Proceeding northeastward to a point opposite the city of Quebec, the Notre Dame Mountains sink to lower and lower elevations, but beyond this they again increase in height, so that in the Gaspé Peninsula they form an uplifted area with a general elevation of from 1,000 feet to 2,000 feet, with many peaks rising above 3,500 feet. Throughout the elevated tract of eastern Quebec the country is largely drained by tributaries of the St. Lawrence, flowing northwestward through defiles which they have trenched across the northeasterly trending ridges.

In the Maritime Provinces the Appalachian system is represented by the broken, hilly district of the northwestern part of New Brunswick, where the general elevation over considerable tracts of country is above 1,000 feet, while a number of hills rise over 2,500 feet above the sea. A second relatively high tract in this province borders the Bay of Fundy, and, though much broken in its westward portion, forms a considerable area of plateau-like country, with a general elevation of about 1,200 feet. Lying between the two hilly portions, a very large part of New Brunswick has a mean elevation of only a few hundred feet, and the same is true of Prince Edward Island The higher land of the peninsula of Nova Scotia forms a central ridge seldom reaching 1,200 feet, though, in what may be regarded as its continuation, in the island of Cape Breton, some higher points attain an altitude of 1,500 feet.

The Appalachian region, though essentially a broken, often rugged, hilly country, contains many fertile, cultivated districts. Among these may be mentioned the valleys of the eastern townships of Quebec, the St. John River Valley of New Brunswick, and in Nova Scotia the Annapolis-Cornwallis Valley that parallels the Bay of Fundy, from which it is separated by the long ridge of North

Mountain. Much of the Appalachian region in Canada is, however, a forested country, traversed by swiftly flowing streams, and, in parts of Nova Scotia and New Brunswick, dotted with small lakes.

2. THE PROVINCE OF PRINCE EDWARD ISLAND[1]

Prince Edward Island, the smallest province of the Dominion, lies at the mouth of the Gulf of St. Lawrence and is separated from the mainland of New Brunswick and Nova Scotia by Northumberland Strait. It is 150 miles in length, varies in width from four to thirty miles, and has an area of 2,184 square miles or 1,397,991 acres, nearly all of which is suitable for cultivation, but it is estimated that only a little more than half of this area is actually under cultivation in field crops.

Anyone who drives through the island along the country roads must be impressed with the appearance of prosperity and comfort everywhere. The farms are neat, clean, and well cultivated, the houses comfortable and homelike; hedges are more common than in any other part of Canada, and everything looks wonderfully fresh and green except when covered with the whiteness of winter snows. The soil of fields and roadways is red and contrasts strongly with the green of the grass, trees, and hedges, and even with the green of the growing grains and vegetables.

Prince Edward Island is distinctly a farmers' and fishermen's province. The island has no mineral resources. Coal is believed to exist at a very great depth, but the cost of getting at it would be so great as to make mining unprofitable in competition with the coal of Nova Scotia. There are few manufacturing industries, and those that do exist are closely related to farm production and the fisheries, such as the preparation of condensed milk, pork packing, starch manufacture from potatoes, and the canning of lobsters.

The fisheries are important. Lobsters and oysters are the greatest source of revenue, but large catches of cod, hake, haddock, herring, and mackerel are made. There are 210 lobster canneries in operation in this province.

[1] Adapted from Watson Griffin, *Canada the Country of the Twentieth Century*, Department of Trade and Commerce, 1915, pp. 31–34. Mr. Griffin is Superintendent, Commercial Intelligence Service, Department of Trade and Commerce.

The soil of Prince Edward Island is naturally fertile, and the farmers believe that when exhausted by over-cropping a good dressing of the mussel mud formed by the decay of oyster, clam, and mussel shells in all the bays and river mouths has a marvelous effect in restoring fertility. In winter, dredging machines are placed on the ice in the bays and dig up the mud for use as a fertilizer. However, with a view to protection of the oyster beds, the Provincial Government has made regulations providing that no dredging shall be done within 200 yards of a live oyster bed and then only when a fishery inspector's permit is given.

Oats, potatoes, and hay are the most important crops, but small quantities of wheat, barley, buckwheat, beans, and peas are produced. The majority of farmers pay little attention to fruit-growing.

Fur Farming. The most interesting feature of Prince Edward farming at the present time is the breeding of fur-bearing animals and especially silver-black foxes. Some years ago two farmers in the northern part of the island, noting that the fur of the Prince Edward Island silver-black fox commanded higher prices than any other fox fur on the London market, entered into a partnership to breed foxes in captivity. The stock was bred from Prince Edward Island wild foxes caught in traps and held in captivity in wire inclosures. The experiment proved a great success; the pelts sold at prices ranging from $100 to $2,000 each, seldom selling for less than $500 a pelt, and the two pioneers amassed large fortunes before the nature of their enterprise became widely known. Their example was followed by others, and it was soon found that more money could be made in selling pups for breeding purposes than in selling the pelts. The demand for silver fox pups became so great that the price steadily increased, and at the time the great war broke out five months' old silver fox pups of the best Prince Edward Island stock were selling at from $12,000 to $16,000 per pair, and old stock of proved fecundity realized as much as $35,000 per pair. When the pups could be bought at from $1,000 to $4,000 per pair a number of farmers started fox ranches, but when the price went up to above $10,000 it became impossible for the ordinary farmer individually to buy foxes. Then it occurred to someone to organize joint-stock companies for fox-breeding purposes. In April, 1914, there were in Prince Edward

Island 194 limited liability joint-stock companies that had been organized for the purpose of breeding fur-bearing animals, chiefly silver-black foxes. These companies had an authorized capital of $31,232,700, but a number of the companies have not yet been floated, and probably not more than half the stock has been actually issued. A large proportion of the farmers of Prince Edward Island are said to have invested in the stock of fur-farming companies. The farmers of the island have always been prosperous. They had large sums of money in the savings banks, and the huge dividends paid by some of the companies induced general investment in stock of fur-farming companies. Besides the joint-stock companies about three hundred individual farmers are registered as having ranches for breeding fur-bearing animals.

Very few silver fox pelts have been sold in Prince Edward Island in recent years owing to the great demand for breeding stock, but it is generally agreed that as the silver foxes on the ranches are rapidly increasing the industry will come down to a pelt basis in a few years. The fox reproduces rapidly and comes to maturity in eight months. In 1914 some breeders estimated that it cost fifty dollars a year to feed a pair of foxes. In that year the average price of wild silver fox skins in London was about two hundred dollars, and for ranch foxes such as are found with the best ranchers, twelve hundred dollars. Wild silver fox skins are not always prime, and they are frequently shot, chewed, mangled, and poorly dressed, while ranched foxes are usually killed when their fur is in prime condition. The highest price ever paid at the London sales for a silver fox skin was $2,900. Prince Edward Island's example is being followed in other provinces of the Dominion, especially in the other Maritime provinces.

The Population of the Island. The population of Prince Edward Island at the census of 1911 was 93,728, that is 42.91 per square mile, while the population of the whole Dominion was only 1.93 per square mile. But while Prince Edward Island seems quite densely populated compared with the whole Dominion of Canada, the population is not dense compared with that of many other countries. The state of Rhode Island, with an area of 1,248 square miles compared with Prince Edward Island's area of 2,184 square miles, had a population of 542,694 at the last census. Rhode Island is a manufacturing state, but we may compare Prince Edward Island with the islands

of Jersey and Guernsey in the English Channel, which are purely farming and fishing communities. Jersey and Guernsey have together a little over 93,000 people, almost exactly the same population as Prince Edward Island; yet their combined area is only 69½ square miles. Prince Edward Island, with over thirty-one times the area of Jersey and Guernsey and nearly the whole of its area very fertile, with a climate most favorable to human life and to all kinds of live stock, with fish in abundance in the surrounding sea and all the bays and river mouths, might have a population of over three millions and yet be less densely populated than the Channel Islands. It is not probable that Prince Edward Island will ever be so densely populated as the Channel Islands, but this comparison will make it evident that there are still possibilities of great expansion in Canada's smallest and most densely populated province.

3. AGRICULTURE IN NEW BRUNSWICK[1]

There are 17,910,400 acres of land in the province, and it has been estimated by experts that over ten million acres are suitable for agriculture. Of the remaining acreage a considerable portion could be made available for agriculture by drainage. Millions of acres still belong to the Crown and can be obtained by settlers as free grants. While there is good farm land in every county, the counties having the largest areas of fertile land are Carleton, Victoria, Madawaska, Restigouche, King's, and Queen's. The recent construction of railways has made much of this land that was formerly inaccessible available for settlement. The rivers of New Brunswick run through tracts of low-lying alluvial land of remarkable fertility, sometimes extending for miles back from the river, but generally less than a mile wide. These low lands, which are called intervals, are partly covered with water in the spring. Without dyking and without manure they produce great crops of fine hay every year. When dyked and brought under cultivation they prove to be remarkably fertile. New Brunswick has so many great rivers that the area of intervals is extensive, but these lands are usually attached to upland farms. The Crown permits no land to be thrown open for settlement unless it is well served by roads and is adaptable to agriculture.

[1] Adapted from Watson Griffin, *Canada the Country of the Twentieth Century*, Department of Trade and Commerce, 1915, p. 55.

4. BAY OF FUNDY TIDES[1]

The most important seafront of New Brunswick is along the Bay of Fundy, for this great inland sea gives the province a winter port which is always open. The Bay of Fundy, which almost completely separates Nova Scotia and New Brunwsick, is noted the world over for its peculiar tides, which are generally supposed to be even more extraordinary than they really are. They are often said to rise as high as seventy feet, whereas official records show that they never exceed fifty-five feet at any point and do not average more than thirty feet. The highest rise is along the the Chignecto Isthmus and in the Basin of Minas on the Nova Scotia side. At St. John, the winter port of New Brunswick, the spring tide is twenty-seven feet and the neap tide twenty-three feet. The great tidal waves, rushing up the rock-bound bay, turn inward wherever they find an opening made by a river and ascend its channel under the name of tide bores, so that in Nova Scotia river beds which ordinarily contain nothing but rivulets are full of water at flood tide. On the New Brunswick side the rivers, being much more important, do not dwindle to rivulets when the tide is out, but there is a very great difference in the volume of water near their mouths at high and low tides. When the tide is out, vast muddy flats are left bare, and it is only during spring tide that they are entirely covered. Thousands of acres of these marsh lands near the river mouths, both in Nova Scotia and New Brunswick, have been reclaimed by dyking, and the land thus made available for agriculture is of extraordinary fertility, producing astonishing crops for years without manure. The alluvial mud is sometimes carried to the uplands to be used as manure.

5. FOREST RESOURCES OF MARITIME CANADA[2]

It is estimated that in Nova Scotia the mainland has approximately 9,000,000,000 feet and Cape Breton 1,000,000,000 feet of coniferous timber suitable for sawing. This timber will yield about 24,000,000 cords of pulpwood of which 10,000,000 cords are on the mainland and 14,000,000 cords on Cape Breton. In addition, there are 330,901 acres of hardwood timber on the mainland and 195,968 acres on the island. Forests and burnt-over forest areas occupy

[1] Adapted from Watson Griffin, *Canada the Country of the Twentieth Century*, Department of Trade and Commerce, 1915, p. 53.

[2] By Charles C. Colby.

two-thirds of Nova Scotia. Most of these lands are non-agricultural and should be maintained permanently as forests.

Indiscriminate cutting and forest fires have so decreased the stands of white pine in New Brunswick that at present but little of this lumber is produced. The second growth is mainly spruce which with the original stands of spruce make the annual cut of that timber ten times as great as that of pine. Prince Edward Island has but small areas of forest because most of it is cultivated.

It is estimated that there are about 10,000 square miles of timbered lands in Newfoundland. Most of this timber is in the valleys of the major streams and about the ponds and lakes. Spruce, balsam, fir, and hemlock form the basis for the notable development of paper manufacturing which has occurred since 1905. British companies operate large pulp and paper mills in the island and, in 1913, produced 17 per cent, and, in 1915, 45 per cent of the newsprint paper used in England. The advantages for paper manufacturing in Newfoundland are that (1) timber is cheap and the fiber of the wood excellent, (2) the timber occurs in dense stands, (3) the topography and drainage make it easy to get the logs to the mills, (4) most of the forests are near the sea, (5) the ports on the south are free from ice so that, in contrast to the St. Lawrence ports, overseas shipments can be made throughout the year, (6) Newfoundland is much nearer the British markets than Canada or the United States, and (7) labor is plentiful and, compared with Canada and the United States, moderately cheap in price. The cheapness of labor is due to the absence of competing industries, to the existence of a pioneer scale of living, and to the fact that the fishermen are employed in the logging camps during their off season.

6. THE APPLE INDUSTRY IN NOVA SCOTIA[1]

Apple orchards in Nova Scotia are what orange and lemon groves are in California—a staple industry known far and wide and a lodestone to attract desirable settlers. At present the Annapolis-Cornwallis Valley is considered the most suitable region for apple growing, but the Provincial Government has shown by practical experiment that other parts of the province are likely to claim attention. The

[1] Adapted from *Natural Resources of Nova Scotia*, Natural Resources Intelligence Branch, Department of the Interior of Canada, 1920, pp. 39–40.

danger in certain districts lies in late spring frosts and in unusually severe winters. As the citrus fruit industry in Florida or California grows in spite of an occasional year of killing frost, Nova Scotia can well afford on rare occasions to lose a percentage of its crop as in the windstorm of August 10, 1917. The record year was 1911 when 1,734,000 barrels were packed and sold from the Annapolis Valley and neighbourhood alone. In "off years" the pack may fall to one-half of the above figure.

The United Fruit Company of Nova Scotia embraces forty co-operative fruit companies and does most necessary work in market ing and regulating shipments, and in buying fertilizer and implements wholesale. In 1914 one cent a pound covered every expense after picking to delivery at the London docks.

The principal market is Great Britain, but South Africa took 10,000 barrels in 1914, and a South American market is claiming attention.

Nova Scotia as a province has won the gold medal of the Royal Horticultural Society for apples in competition with other parts of the Empire, while individual exhibits at the same time took fourteen medals.

The Annapolis Valley—"The Garden of Nova Scotia"—stretches for seventy miles from the head of Annapolis basin to the Bay of Minas with a varying width of from 10 to 15 miles. North Mountain, lying along the Bay of Fundy from Cape Blomidon southwest to Brier Island, forms a barrier that shelters it from the northwest winds and fogs, and parallel to this is South Mountain on the other side of the valley. Of the enclosed valley area only about one-tenth is under cultivation. The price of land varies from $60 per acre to $200 for a six-year-old orchard and $1,000 for one in full bearing. As in other parts first settled by the French, the farms are usually in narrow strips of from 20 to 120 acres, having meadow hay land in the bottom, orchard land midway, pasture and wood above.

A full-bearing orchard of ten acres should provide ample work for a settler and a fair living, but adjoining land for mixed farming is a comforting possession in an "off year." Even in the special fruit-growing areas mixed farming is recommended as an adjunct to the orchard, for, though it is possible to maintain fertility by the ploughing under of green crops and by commercial fertilizers, real stability is

best obtained by catch crops such as potatoes, beans, roots, or flax. Farmers with the live stock necessary to keep the land in good shape for such crops weather best a lean fruit year and have, to boot, the more fertile soil.

7. SEA-FISHERIES OF EASTERN CANADA[1]

The fisheries of Eastern Canada at the present time fall thus into two distinct divisions, the deep-sea and the in-shore or coastal fisheries.

The in-shore fishery is the more important of the two, inasmuch as it employs about eight men for one that is employed in the deep-sea fishery. It is carried on in boats carrying two or three men, and at a distance of from one to five miles from the shore. A small class of vessels, carrying four to seven men, is also used on the nearer "banks" lying twelve to fifteen miles out; while many fixed fishing contrivances, such as traps, drag-seines, and weirs, are operated from the shore. Boats engaged in the hook-and-line fishery leave harbour about daybreak and return in the course of the afternoon, while vessels of the small class remain two days and sometimes a week on the fishing grounds before returning to harbour.

The kinds of fish taken from the in-shore waters are cod, hake, haddock, pollock, halibut, herring, mackerel, shad, alewives, smelts, flounders, swordfish, sardines, salmon, lobsters, oysters, and clams. Herring is the chief baitfish used in line fishing; but when these are scarce, clams are largely used as a substitute. Squid, a kind of cuttlefish, when obtainable, is a favourite bait.

The deep-sea or bank fishery is pursued in substantial fore-and-aft rigged sailing vessels of from 60 to 100 tons, carrying crews of from 12 to 20 men. Operations are conducted on the many shallow stretches known as "banks" which lie between the outer edge of the in-shore area and the deeper waters of the Atlantic, ranging from the "Grand Bank" lying southward of Newfoundland to "Browns Bank" off the western end of Nova Scotia, also on the many banks in the Gulf of St. Lawrence, around the Magdalen Islands, and between Cape Breton and Newfoundland. The fish are split and salted down in the hold of the vessels at the end of each day's fishing,

[1] Adapted from J. J. Cowie, *Sea-Fisheries of Eastern Canada*, Commission of Conservation of Canada, 1912, pp. 97–109. In 1912 Mr. Cowie was connected with the department of Marine and Fisheries.

and when the hold is full, or the supply of salt gives out, the anchor is hove up, and a course shaped for the land. The kind of fish taken by vessels on the off-shore grounds are cod, haddock, hake, and halibut.

Of all branches of the fisheries of the east, the most important is the cod fishery, and so far as money value is concerned, it remains the leading branch of the Atlantic coast fisheries. The counties along the south shore of Nova Scotia produce the largest quantities of this fish; but the majority of the fishermen of this district give their whole time and attention to fishing, and are in possession of a fine type of fishing boat. These facts account for their success in this as in other branches of the industry.

Of all the cod-fishing waters of Eastern Canada, probably the most prolific are those of the Gulf of St. Lawrence, around the Magdalen Islands, on the north and east coasts of Prince Edward Island, the north coast of Cape Breton and in Chaleur Bay. In addition to this, the shores of the Gulf are rendered exceptionally advantageous for fish-drying, owing to their immunity from the fogs that sweep in upon the southern or Atlantic coast of Nova Scotia; and there can be no doubt that but for the inferior type of boat used, and the fact that many of the fishermen around the shores of the Gulf cease operations during the very height of the season to attend to the work of the farm, the value of the cod fishery of that portion of our coasts could be enormously increased.

The catches of both the in-shore and the off-shore fishermen are mostly all split and salted for drying purposes. There is a vast difference, however, between the dried products of the two modes of fishing. Cod that is split on board of a deep-sea vessel is heavily salted, in order to preserve it during the fishing voyage, which sometimes lasts a couple of months; and being so thoroughly impregnated with salt, it does not make good dried fish, but is apt to become slimy when transported to hot climates. On the other hand, in-shore fish are landed daily, split, and placed in salt for a short time only, then dried. The curing is, therefore, due less to the salt than to the action of the sun and air, so that fish cured in this manner may be safely exported to hot climates and stored there without deteriorating. To overcome the difficulty, caused by the frequent presence of fog on the shores of the Bay of Fundy and on the southern shores of Nova

Scotia, drying by artificial means has been resorted to. This consists of a system of steam or hot water piping, over which are placed trays containing the fish. They are there submitted to a temperature of 90 to 95 degrees Fahrenheit for a few hours, and when thoroughly warmed, alternate currents of cool and warm air are forced over and under them, the moisture being meantime carried off by suitable ventilators. Drying by this process is accomplished in about forty-eight hours, as against three weeks by the sun and air process.

The chief markets for dried cod are found in Italy, Spain, Portugal, Brazil, the West Indies, and the United States. The largest and best fish are sent to Europe and Brazil; and the inferior kinds to the West Indies. The total value of cod taken by the fishermen of Eastern Canada during the year 1909–10 amounted to $3,847,844.

Haddock, hake, and pollock are taken largely by the in-shore fishermen while fishing for cod.

Haddock are abundant in the Bay of Fundy, in the waters along the whole Atlantic coast of Nova Scotia, and in the southern portions of the Gulf of St. Lawrence; but they do not frequent the northern shore of the Gulf. The chief haddock season occurs in the latter part of the year, at which time the fish swarm into the bays and harbours of Nova Scotia and New Brunswick, when great catches of them are made by boat fishermen. In the spring and summer, haddock are mostly split and dried, and are marketed chiefly in the West Indies. In the fall and early winter, the catches are mostly shipped in a fresh state or as smoked finnan haddies to the inland towns and cities of Canada. The value of the haddock catch in 1910 amounted to $829,553, seven-eighths of which was produced by Nova Scotia.

Halibut are usually found wherever cod are met with. The fishery is not, as a rule, prosecuted as a distinct one, the fish being taken in considerable quantities by the cod fishermen. These fish generally inhabit deep gullies near the shore or between the "banks."

The annual catch of halibut has not increased in the course of the last twenty-five years; but being a fish that is consumed fresh, its value has in recent years been enhanced considerably by means of improved facilities for transporting it to inland centers of population. At one time fishermen, when anxiously fishing for cod, looked upon the halibut as a pest; now it is commonly worth eight to ten cents a

pound as it comes from the water. There were 14,970 cwt., valued at $153,400, taken in the year 1910, about six-sevenths of which was taken by Nova Scotia fishermen.

Although the herring fishery falls below some others in money value, it is in some respects the most important of all the Eastern Canadian fisheries, inasmuch as the success or failure of the great hook-and-line fishers depends to a great extent on the abundance or scarcity of the supply of herring for baiting purposes.

In the spring of each year, without fail, large masses of herring move close in to the shore, and are literally washed up on the beaches, in many parts of the Gulf of St. Lawrence, especially. The mode of capture is by fixed trap and gill nets set close to the shore, and, so long as the mass of fish remains in-shore, large quantities are taken. The spring herring is poor in quality; but it provides an abundant supply of fresh bait for the cod fishing fleet in its first voyage to the "banks," while much of it is salted and stored for bating lobster traps throughout the lobster-fishing season. In the summer and fall, herring of an extremely fine quality abound; but they do not come so near the shore as in the spring, and, as a consequence of the use of the same fixed fishing gear, the summer catch is a small one. Thus, not only are the operations of the great cod fishing fleet seriously hampered for want of a steady supply of bait when most needed, but only an insignificant quantity of this summer herring of unsurpassed quality is prepared for consumption as food.

It has been demonstrated by an experiment conducted by myself, that, by the use of what are known as drift nets such as are used in the British herring fisheries, abundant supplies can be secured through all the summer months, ten, twenty or thirty miles from shore; and if our fishermen could only be prevailed upon generally to adopt similar methods, a large increase in the value of this fishery would be insured.

The total value of herring fishery of Eastern Canada in 1910 amounted to $1,702,493; but it has to be recorded that twenty-five years earlier the value obtained from this fishery by the four eastern provinces amounted to $2,016,019.

In the light of the extreme abundance of herring on the Atlantic coasts, it is to be deplored that this branch of the fisheries is as yet practically undeveloped. Of the comparatively small proportion of the annual herring catch that is smoked and cured in pickle, part

is consumed in Canada and part exported to the United States and the West Indies; but owing to careless packing and badly made barrels, the price obtained is not such as to induce those engaged in the business to increase the output.

Since 1908, steam trawling, the latest and most successful mode of capturing large quantities of fish ever put into operation, has been tried in a small way on the coast of Nova Scotia. This method consists in the dragging, by a steam vessel, of a strong, bag-shaped net over the sea-bottom, for the capture of all kinds of fish.

It is a fact that wherever this style of fishing has been introduced, it has been denounced in the most decided manner by fishermen who use hooks and lines. They, not unnaturally, fear, firstly, the effects on the fresh-fish markets of the greater catching power of the trawler; secondly, the depletion of the in-shore fishing areas by over-fishing, and lastly, the possible destruction of their fishing gear by the sweep of the trawler's net.

Trawling is an expensive mode of fishing, and requires a large and ready outlet for all kinds of fish in their fresh state, at good prices, the price of salt fish being generally too low to permit of profitable working for that trade alone. There is, therefore, some reason for the fears recently expressed by Canadian line fishermen that a rapid development of this mode of fishing would so continually over-supply the, as yet limited, though growing, fresh-fish markets of Canada as to render both line and trawl fishing unremunerative.

With the increasing application of modern methods, arises the question: Will the vaunted abundance of fish in Canadian waters remain unaffected? This question can be only answered by a study of the records of the fisheries of European waters, where steam trawling has been carried on so long, and where the fleets are so large. There, in the comparatively narrow North Sea, what would in Canada be called excessive fishing to a superlative degree goes on from January to December, year in year out, by an immense fleet of trawling and other steam vessels without let or hindrance except within the three-mile limit.

I would merely point out here, that climatic conditions in Canadian waters provide a natural protection against depletion. For three or four months in each year there is an enforced close time, during which little or no fishing takes place, and during which even

the operations of steam trawlers would be brought to a standstill, owing to the severity of the weather. Indeed, the Gulf of St. Lawrence—that immense fish-breeding area—is virtually closed to fishing from December to May, which period, mark you, covers the spawning season for cod, haddock, hake, and such fish.

In view of the fact that it would be utterly impossible to convince the government of France as to the alleged ruin the method works on the "banks," I do not see how trawling can be totally prohibited on this side of the Atlantic; I would, however, heartily welcome some international arrangement whereby trawling might be prohibited within at least twelve or fifteen miles of the shore, and regulated for the benefit of the thousands who depend for their livelihood on what the baited hook captures.

8. MARKETING SEA FISH IN CANADA[1]

It was not until 1906 that any organized effort was made by Canadian interests to supply the markets of Ontario and Quebec with fresh sea fish. This was due in part to the fact that such important American fishing ports as Portland, Gloucester, and Boston were considerably closer to Montreal, Toronto, and other centers in Ontario than are Halifax and Mulgrave. This gave American shippers the advantage of better express and freight rates which enabled them to overcome the duty of one-half cent (later raised to one cent) a pound. Not only that, but the Canadian Atlantic fisheries were carried on, for the most part, during the summer months only. This made the shipment of fresh fish, except in refrigerator cars, all but impossible. Consequently, the dealers in central Canadian cities found it to their advantage to secure fresh fish from American ports where the service was steady and reliable.

In 1906, however, certain Nova Scotia fish dealers made arrangements with the railway companies for a Saturday cold storage car between Mulgrave and Montreal. This service is still in operation and has marketed large quantities of fresh fish in Quebec and Ontario. In September, 1907, the Department of Marine and Fisheries entered

[1] Adapted from Allan Donnell, "The Canadian Fresh Sea Fish Trade," *Sixth Annual Report, Commission of Conservation of Canada*, 1915, pp. 180–82. Mr. Donnell was assistant editor of the Commission of Conservation in 1915.

into agreements with the Intercolonial and the Halifax and Southwestern railways, which provided for the attachment of refrigerator cars for fish to the fast freight trains leaving Halifax on Saturdays and Mulgrave on Mondays for Montreal. This service was undertaken on the understanding that the Department guaranteed the railways that, on each trip west, these cars would earn at least two-thirds of the regular charge on carload lots of 30,000 lbs., in addition to cost of icing at minimum carload rates. This freight service guarantee cost the Department $208.37 during the fiscal year 1907–8. The following year, the first full year that the plan was in operation, it cost $1,943.89. In 1909–10 the guarantee was reduced to $481.29, after which the service became self-sustaining. Since 1911, however, it has not been much used from Halifax, as the express service meets the requirements of that point better.

A freight service is likely to be slow and uncertain and, to offset this, the Department, in the spring of 1908, arranged for an express service. This arrangement provided for a refrigerator car to be attached to the Marine express one day a week, to transport fish to Montreal, at a rate of $1.00 per 100 lbs. from Halifax and $1.05 per 100 lbs. from Mulgrave. The service did not prove popular, however, and was soon discontinued. Its failure was probably due in part to the fact that it was limited to one day a week, as well as to the necessity for the consignee taking charge of shipments at the car. In the autumn of the same year, new arrangements were made with the express companies whereby one-third of the charges on shipments to points as far west as the eastern boundary of Manitoba were to be met by the Department. This gave a rate of $1.00 per 100 lbs. from Halifax and Mulgrave to Montreal. The plan proved to be very successful and resulted in great increases in the sales of Canadian fresh sea fish in Ontario and Quebec. Coincident with this there was a decided falling off in the imports of fresh fish from the United States into these provinces. Thus, in 1906, the imports in question amounted to 1,968,572 lbs., in 1908 they had fallen to 1,180,543 lbs., and, in 1910, to 761,569 lbs.

It is obvious, however, that the ordinary express service, when used for the transportation of fresh fish, has distinct limitations. Hot weather in summer and the fact that the regular cars are artificially heated in winter tend to make them unsafe for such a purpose.

Refrigerator cars are not only an advantage but practically a necessity. Last year a limited refrigerator express service from the Maritime Provinces to Montreal was inaugurated. A refrigerator express car leaves Mulgrave every Saturday, and shipments from Halifax are consolidated in this car at Truro. In addition to paying one-third of the ordinary express charges on shipments forwarded in this car, the Department has guaranteed the express companies that the earnings per trip will, at least, aggregate the charges on 10,000 lbs.

The fresh fish trade of the Pacific coast is also expanding rapidly, the halibut trade being in an especially thriving condition. Credit for this is probably partly due to the requirements of the American markets. The growing scarcity of halibut, coupled with the difficulty of securing winter supplies on the stormy Atlantic coast, led certain New England fishery interests to attempt the exploitation of the halibut fisheries near Queen Charlotte Islands, off the British Columbia coast. This fishery is now one of the most flourishing halibut fisheries in the world. The opening of the Grand Trunk Pacific Railway will enlarge the market, and it is of interest to note that the first carload of halibut from Prince Rupert, over the Grand Trunk Pacific, reached Toronto the first week in October, 1914. An extensive carload-lot trade is being carried on with Toronto and Montreal and, to a less extent, with Calgary and Winnipeg. These latter shipments, of course, do not cost the Department anything.

9. THE RELATION OF COAL TO INDUSTRY AND COMMERCE IN NOVA SCOTIA[1]

Nova Scotia has the only coal yet discovered on the Atlantic seaboard of America. The coal is bituminous, of good quality, some of the seams being particularly suited for steam-making and for the manufacture of coke for blast furnace use, while others are better adapted to the production of gas. There are extensive beds of coal with seams of great thickness on both the eastern and western coasts of Cape Breton Island, in the central county of Pictou and in Cumberland County at the extreme west of the province. Mining operations are carried on in each of these sections, so that there are mines convenient not only to all parts of the province of Nova Scotia but

[1] Adapted from Watson Griffin, *Canada the Country of the Twentieth Century*, pp. 39–44.

also to Prince Edward Island and New Brunswick, while in summer shipments can be made from all the mines by way of the St. Lawrence River to the Province of Quebec. During the year 1913 the production of coal in Nova Scotia was 7,203,913 tons, of which 3,341,768 tons were consumed in the Maritime Provinces of Canada, 210,544 tons in New Foundland, 2,193,228 tons in Quebec Province, 21,391 tons by time chartered boats, 234,177 tons for bunkering, 468,090 tons in the United States, and the remainder in other countries.

Manufacturing Industries. The sales of Nova Scotia coal for consumption in the Province of Nova Scotia have increased 86 per cent within ten years. This great increase in local consumption is due to the recent development of manufacturing industries. Not many years ago the province had very few manufactures. Now there are about 1,500 manufacturing establishments with nearly 30,000 employees.

The greatest of the industries is the manufacture of iron and steel. British success in supplying foreign markets with iron and steel has been largely due to the fact that the United Kingdom had extensive supplies of coal and iron ore close to the seaboard and could get supplies of iron ore conveniently from other countries, while the geographical position of the country is favourable to a world-wide commerce. Nowhere else can conditions be found more nearly similar than in the Canadian island of Cape Breton. Coal is very widely distributed in Cape Breton, but the most valuable seams are those included in the coal field of Sydney, extending from Mira Bay on the east to Cape Dauphin on the west, a distance of 31 miles, and occupying a land area of over 200 square miles, besides extensive submarine areas. The greater part of these coal areas are controlled by the Dominion Steel and Coal Company and the Nova Scotia Steel and Coal Company, the former now operating seventeen collieries and the latter five collieries.

In considering the future prospects of iron and steel manufacture in Cape Breton the first factors to be taken into account are the character and extent of the raw materials, iron ore, limestone and fuel, their distance from each other and the means of transportation. The supplies of coal and limestone for the Cape Breton blast furnaces are close at hand, but the iron ore is brought from Great Bell Island in Conception Bay off the coast of Newfoundland about 400 miles from

Sydney harbour. English mining engineers have estimated that there is enough ore in the areas already opened up by the Dominion Steel Company to supply a plant larger than that now in existence at Sydney for over a hundred years and there are other areas belonging to the company which, if the seams are continuous as is supposed, would in their opinion probably yield a much larger quantity of ore than the areas now being worked. The ore has a good percentage of iron. It is low in sulphur but rather high in phosphorus. It can be mined very cheaply and as the mines are close to deep-water docks, while the blast furnaces are on the water front of Sydney harbour with deep-water docks at hand it is claimed that the iron ore can be delivered at the furnace at lower cost than at any other blast furnaces in America except in the state of Alabama where iron ore and coal lie near together.

In converting coal into coke for use in the blast furnaces at Sydney by-product ovens are used, and in addition to obtaining large quantities of gas for use at the works, tar and ammonium sulphate are recovered. There is a good market for the sulphate of ammonia on the sugar plantations of the West Indies. From the tar by distillation pitch, light volatile oils, creosote, carbolic acid and benzol are obtained.

Commercial Position of Cape Breton. It is an extraordinary fact that the harbours of Sydney and Louisburg, while more than 2,200 miles nearer to Liverpool than Mobile and New Orleans, the nearest ports to the southern blast furnaces are at the same time, about 600 miles nearer Pernambuco, Rio Janeiro, and Buenos Ayres, and about 900 miles nearer to Cape Town, South Africa. Ham-shaped South America lies far to the east of North America, while New Orleans, Mobile and other ports on the Gulf of Mexico are a long distance west of the Atlantic Ocean. Moreover, ships from southern ports of the United States cannot take a direct route because they have to steer clear of the West Indies Islands. Cape Breton, jutting far eastward into the Atlantic, is much nearer to a direct line drawn north from the east coast of South America than the ports of the United States.

In considering Sydney's advantages as a steel and coal center in comparison with other localities in America, it must be remembered that the coal mines and steel works of the United States are not near

the sea coast, and their products must be carried hundreds of miles by rail to reach a port.

10. MANUFACTURING IN NOVA SCOTIA[1]

Of the 21,306 manufacturing establishments in Canada in 1915 Nova Scotia, ranking fourth among the provinces, was credited with 968, distributed among 86 industries. The capital invested was $126,539,183 and the employees were 33,581. The falling-off from the 1480 in 1910 was due to the inactivity in the lumber trade and the closing of 568 sawmills, a state of things now greatly changed during the period of reconstruction. The government of Great Britain alone expects to build 1,600,000 houses in the next ten years, the wood for which will have to be imported.

Of the Nova Scotia manufacturing plants, those with a product value exceeding a million dollars were:

	Value of Products
Iron and steel products	$10,087,013
Railway cars and car works	6,457,279
Fish (preserved)	4,436,413
Logs, lumber products	3,418,921
Bread, biscuits, etc.	2,670,459
House building	1,359,560
Electric light and power	1,192,825

NOTE.—The iron and steel industry in the year 1915 owed an increase of more than five millions to the war, and car products more than a million.

Apart from the steel and iron manufactures centered in Cape Breton Island and Pictou County, where the proximity of iron and coal insures a busy future, the chief industrial towns are Halifax (including Dartmouth), Truro, and Amherst. In these centers the main industries are chocolate, biscuits, and confectionery, office and other furniture, textiles and clothing, hats and caps, condensed milk paint, railway cars, oil and sugar refining.

The physical position of Nova Scotia, generally, offers great inducements to the industrial investor; she has a certain amount of water-power, and abundance of coal; she has plenty of raw material of her own, and many fine harbours where that from foreign-countries,

[1] Adapted from *The Resources of Nova Scotia*, Natural Resources Intelligence Branch, Department of the Interior of Canada, 1920, p. 53.

e.g., sugar-cane, cacao, tobacco, or cotton, can be laid down cheaply, and from which a whole fleet of ships built in the province can sail abroad.

11. A GEOGRAPHICAL STUDY OF NOVA SCOTIA[1]

Two hundred years ago Nova Scotia was nearly if not quite as promising a colony as Massachusetts. Its position was more strategic. Its climate was as good and its resources were superior. Massachusetts has no equal area of farm land as fertile as the Annapolis Valley. It has a longer coast line, fringed with harbors. Louisburg, the French stronghold on Cape Breton Island, was scarcely second in importance to Quebec. Halifax was founded and fortified by England in 1749 as a counterpoise to the French Louisbourg, and the taking of this fortress by the New England troops was one of the great events of colonial history. Port Royal on the Bay of Fundy was the first permanent settlement in North America north of Florida. The importance attached to Port Royal is shown by the fact that it was five times taken by the English, unsuccessfully attacked by them three times, and by the French and Indians twice. It was sacked and abandoned twice, once by pirates and once by United States Revolutionary troops. The ruins of its fortifications cover 28 acres. After the Revolutionary War, more than 25,000 people—the United Empire Loyalists—left the states and selected Nova Scotia and New Brunswick for their home. Even in 1800 most people saw as prosperous a future for New Scotland as for New England. Writing in 1787, Hollingsworth says in his book on Nova Scotia:

"This country [Nova Scotia], as has been already observed, may be justly esteemed the first in the American world, with respect to that situation, whether in peace or war, which a great maritime power, possessed also of settlements in the West Indies, would wish to retain and improve."

Yet today the total population of Nova Scotia is less than that of Boston, and its average density is equal to that of Oklahoma. There are ten cities in Massachusetts any one of which manufactures more than Nova Scotia, and the semi-annual *profits* of the United

[1] Taken from R. H. Whitbeck, "A Geographical Study of Nova Scotia," *Bulletin of the American Geographical Society*, June, 1914, pp. 413–19. Mr. Whitbeck is professor of geography at the University of Wisconsin.

States Steel Corporation in time of active business would pay for the total yearly manufactures of Nova Scotia.

Nova Scotia lies nearer Europe than does New England; it was settled by the best of European stocks, English, Scotch and Germans, and some Irish, with a large admixture of New Englanders. It has ample supplies of coal and limestone at the water's edge, while only a day's run to the north are the iron mines of Wabana, Newfoundland, also at the water's edge. Moreover, the province lies at the entrance to the River and Gulf of St. Lawrence, the gateway into Canada.

If a rigorous climate, thin soil, Atlantic waterfront, many harbors and North European stock account for the phenomenal development of New England, why have these same factors not led to similar results in Nova Scotia? And still more, since the latter has coal and the former has none?

The province has 21,000 square miles, more than half of which is forest well culled and much injured by fires. Three-eighths of the land is in farms, but half of this is wooded. Not over 20 per cent of the total area is suitable for farming. The peninsula is peneplained to a relief of about 400 feet in the south, rising to nearly 1,000 feet in Cape Breton; it is underlain in part by ancient slates and quartzites, intruded by massive batholiths of granite and is also underlain by Paleozoic rocks. The entire surface was thoroughly scraped by glaciers and the southeastern shore is deeply fiorded. The coal measures are in Cape Breton Island and along the shore of Northumberland Strait. Parallel to the Bay of Fundy runs the high trap ridge known as North Mountain, of the same origin and age as the trap ridge of New Jersey and the Palisades of the Hudson. Opposite this and eight miles away extends the granite wall of South Mountain, and between lies the paradise of Nova Scotia, the Cornwallis-Annapolis Valley, eroded in the soft red shales of the Triassic. This is the principal valley of the province, the home of prosperous and well-housed farmers and apple growers. The granite and quartzite knobs are bare, the soil on the slopes is thin, and most of the crops are grown near the roads on the so-called interval, or valley land, or on the rich tide-marsh reclaimed from the sea by the dikes which the Acadians built or taught others to build. These reclaimed lands are made of sea mud washed into the estuaries by the powerful tides. They are the most valuable meadow lands of the province, producing

as high as three tons of hay to the acre year after year. The general aspect of much of the country, with its wide stretches of cut-over and burned-over land, is not prepossessing. The farm houses are small and crops are light. The average farm of the province is valued at about $2,000 and it produces from $300 to $500. The Cornwallis-Annapolis Valley, eighty miles long and eight wide, is almost a continuous orchard. Protected on the north and south by mountain walls of considerable height and possessed of rich red soil, it is ideally suited to apple growing, and annually exports $2,000,000 worth of fruit. A single tree is officially reported to have borne 35 barrels in one year.

Next after the valley, the area of Paleozoic rocks in the north, bordering on Northumberland Strait, is agriculturally best developed. The part of the province that faces the Atlantic is the poorest and half of this is a wilderness traversed by no railroad. Even Halifax County is so little developed that it is one of the chief moose-hunting grounds of the province. Despite the continuous fringe of harbors, there is but one important port, Halifax, The port of Lunenburg in the German settlement is the chief fishing center.

The Fisheries. The nearness of the fishing banks, the many-harbored coast and the scanty soil had the same influence in Nova Scotia as in New England. In both regions these influences bred a race of boat-builders, fishermen and sailors. In the days of wooden ships, the coast of Nova Scotia, like the coast of Maine, was busy with the building of sailing vessels, and, like those of Maine, many of the shipyards of Nova Scotia are now idle. But the influence of the fisheries has left its impress upon almost every phase of the life of the province, and fishing is now and will continue to be one of the principal industries. In registered tonnage per capita, Nova Scotia vies with Norway.

The Mines. One of the few places in the world where coal is mined at the sea shore, in fact two miles out under the sea, is in Nova Scotia. The Sydney coal field in Cape Breton occupies 200 square miles and is bounded on three sides by salt water. In Pictou County are seams 24 to 30 feet thick. Nova Scotia produces two-thirds of the coal mined in the Dominion. The coal from the Sydney mines in Cape Breton is taken to Quebec and Montreal on specially constructed steamers at a small cost per ton. Off the eastern coast

of Newfoundland is the strange little island of iron ore whose beds dip under the sea, so that the major part of the ore properties are submarine. How much coal and iron have been put beyond men's reach by the sinking of the land at the mouth of the St. Lawrence no one can tell. At the Sydneys and at New Glasgow are the largest smelting and steel plants of the Dominion. Here on the shore of the Gulf of St. Lawrence the iron ore and coal meet under many favorable conditions of location. It looks as if iron and steel production and the subsidiary industries which live on the steel mills have a future here. Already a little Pittsburg has grown up. If it does not grow into a big Pittsburg it will be the fault of men, not of geography.

All told the extractive industries yield $25,000,000 a year, the value of two dreadnoughts. The value of all manufacturing is $40,000,000 to $50,000,000 a year, with iron and steel the leading item.

Railroads. The railroads of Nova Scotia are probably as numerous and as good as conditions will warrant, but they do not remind you of the Pennsylvania. The government-owned Intercolonial Line crosses the province and terminates at Halifax. It runs two good trains each way daily, one even on Sunday. This Sunday train is a special concession to an unwelcome demand from outside and is not popular in the province. Sunday trains or boats in the Maritime Provinces are not countenanced. However, changes of great moment are under way. The Canadian Pacific has obtained the Dominion Atlantic Line which connects Digby on the Bay of Fundy with Halifax on the Atlantic. This may mean that Halifax is to become the principal Atlantic port of the great Canadian Pacific system. It is understood also that this will be the Atlantic terminal of the Grand Trunk Pacific when it is completed. Vast terminal improvements involving $35,000,000 are now in progress at Halifax, and the people of the old town are slowly getting into a new frame of mind. They see a future for their city.

So much for the material side of the neglected province of Nova Scotia—the province that has been passed by. In its material aspects there is nothing that rises above the ordinary, but there is a side to its history which looms above the commonplace and to this I now ask your attention.

The People. It is not necessary that, when wealth increases, men decay. It is not a demonstrated law that bare hills, or poor land

or a rigorous climate are the necessary environment wherein to breed *men*, but it is a law that a land of great material prosperity, teeming with industry and wealth, attracts its young Alexanders and Shakespeares into the world of business, and they become Harrimans, Morgans, and Rockefellers. Not so with a land placed and endowed like Nova Scotia. In this province there was a migration of some of the same stock that made New England, and into it there came thousands of Scotch, mostly highlanders. From such scions as these, men are bound to grow, and if the material activities of their country cannot absorb their energies, then those energies are turned into other channels. Nova Scotia is, as its name warrants, a Scotchman's province. In Halifax I met the chief engineer in charge of the great harbor and terminal improvements; his name is MacGregor. I met the President of Dalhousie, the leading collegiate institution; his name is Mackenzie. He gave me the opportunity of meeting his right-hand men on the board of trustees; their names are Campbell, McInnes and Mitchell. The provincial premier is George Murray and the Lieutenant Governor is J. Drummond MacGregor.

Nova Scotia has long been the unchallenged leader in Canada in the production of statesmen and scholars. It has furnished three of the premiers of the Dominion, the present incumbent being a Nova Scotian. It has furnished a major part of the college presidents for the rest of Canada. Pictou County is the center of the Scotch population, and this single county has supplied a list of college professors and college presidents that would do credit to a province. From this one country, nine men are now serving or recently have served as college presidents, and as prominent college professors, 18 others, not to mention educators of lesser standing. I met a man whose position and income is that of a railroad ticket agent in a city of 8,000 people. He seemed to regard it as not worthy of comment that all of his four sons have gone through college or are going through. Undoubtedly the richest product of this little province is *men*, men whom it has educated and sent out to the rest of Canada and to the United States.

In striking contrast to Pictou County with its Scotch population, devoted to higher education and producing in a generation or two 27 college presidents and professors, is Lunenburg County on the Atlantic coast, settled in 1752, mainly by German farmers from the

Palatinate and Hanover. Of its 30,000 population, in 1891, 9,000 could neither read nor write. They are an industrious, thrifty, and fairly prosperous people, but they are not making their sons into premiers or college presidents. The influence of the sea and of the fishing banks has made over a race of peasant farmers into the pre-eminent fishing population of Nova Scotia. And a people whose interests—created by their environment—seek occupation in fishing do not stress the intellectual side of life. It is a question which I ask and cannot answer: Suppose the same Scotch colonists who settled in Pictou County had, instead, settled in Lunenburg County, would they in that environment have produced the long line of illustrious men that they have produced in their present environment? It is the old question of racial stock *versus* environment in the making of men.

Nova Scotians are emphatically a religious people. Only 500 people out of the 500,000 are without church affiliation. The seating capacity of the churches practically equals the population. I was told of a recently enacted law in Halifax that limits the number of saloons to one for each thousand of the population. In Nova Scotia, Sunday is Sunday and business stops, trains stop and people go to church.

And now in conclusion: Why has Nova Scotia won the name of "the province that has been passed by?" Why is there such a contrast between the development and present life of New Scotland and of New England, so similarly placed and so similarly peopled? If the hard conditions of farming, the abundant water-power, the momentum of an early start and the intelligence of the people of New England satisfy our quest for the reason of New England's industrial development, why do we not get a similar result in a province just across a political boundary? To me two reasons are clear. One is a matter of political geography and the other a matter of physical geography. The throbbing, buoyant, optimistic, aggressive life of the Republic is partly the fruit of our patriotism and of our faith in our country and partly the result of our exceptional opportunities. Our democratic institutions and our wealth of opportunity have drawn to us a steady stream of new blood always regarded as a menace when it was coming and as a blessing when a new current had set in. No such stream of optimism has until recently fed the life of Canada in general and not even yet, the Maritime Provinces.

These provinces have never shared adequately in the economic development of the Dominion as a whole, and this appears to be, in large part at least, a result of their physical geography, mainly location. When the land at the mouth of the St. Lawrence sank and admitted the sea a thousand miles up the valley, it fixed the commercial meeting place of land and ocean at the foot of the Lachine Rapids, at the island of Montreal. Between the coast of Nova Scotia and the attractive lands of Ontario and Quebec lies a long stretch of unattractive country. Nova Scotia is isolated, damagingly isolated from the real centers of Canadian activity, and politically cut off from its natural neighbor, New England. The great transcontinental railway lines did not find it necessary or expedient to terminate on the shore of Nova Scotia. Until the present, the ports of Montreal and Quebec, in summer, St. John and Portland, in winter, have been used, and Nova Scotia has been passed by. It has had no hinterland, and in this lies one of its greatest contrasts to Massachusetts. Despite its nearness to Europe, most of the Atlantic liners steam to the north up the St. Lawrence, or southward to ports which were more accessible from the interior, and these have received and dispatched the transatlantic trade of Canada. I have encountered no instance of a region seemingly so favorably situated for ocean commerce and which has proved up to the present to be so unfavorably placed.

Nova Scotia, the outpost of Canada on the Atlantic, the colony which was thought to have the best commercial situation in the American world, illustrates, when taken in connection with the St. Lawrence, the fact that it is not usually the point where the land juts farthest into the sea, but the point where the sea pierces farthest into the land, that offers the most advantageous place for the meeting of land and water routes. Canada has developed slowly, and Nova Scotia has been compelled to wait and seems to have been content to wait until the time when the growing industries and ocean trade of the Dominion should make the splendid harbor of Halifax a necessary winter terminal of its great continental railroads. This is now coming to pass. A new spirit of optimism is taking root in the province. The vigorous industrial life of Amherst, New Glasgow, Truro and the Sydneys is an object lesson in the possibilities which Scotia's coal and Newfoundland's iron, meeting under exceptionally favorable geographical conditions, can do for manufacturing and consequently

for the whole economic life of the province. There is no boom on in New Scotland. They are not an effervescent people. Halifax is not Seattle. Yet they believe, and the visitor to their province comes to believe, that Nova Scotia is rounding a corner, and that geographical conditions, which, under a past régime, have retarded her growth, are now likely gradually to reverse their influence.

CHAPTER IV

THE ST. LAWRENCE LOWLANDS

1. DIVISIONS OF THE ST. LAWRENCE LOWLANDS[1]

The St. Lawrence Lowlands, floored with nearly horizontal sedimentary rocks, and bounded on the north by the southern edge of the Laurentian Plateau, represent in Canada the northeastern extension of the great plain-like area of the interior of the continent. Commencing near the city of Quebec, the lowlands stretch southwesterly on both sides of the St. Lawrence, with slightly diverging boundaries, until, at Montreal, the level country is approximately 120 miles wide. Beyond Montreal, the northern boundary pursues a westerly course up the Ottawa Valley to a point about fifty miles beyond the city of Ottawa where a ridge of broken country—a low spur of the Laurentian highlands—projects southerly, crossing the St. Lawrence between Brockville and Kingston to join the elevated Adirondack region of northern New York. Near Kingston, at the foot of Lake Ontario, the lowlands again commence and occupy the portion of the Ontario peninsula lying between Lakes Huron, Erie, and Ontario, and bounded on the north by a nearly straight east and west line from Kingston to the foot of Georgian Bay, Lake Huron.

The region thus outlined, with a length of about 600 miles and an area of more than 35,000 square miles, nearly all fertile farming land, is divisible into three portions, each a sloping, plain-like region, usually mantled with heavy deposits of glacial drift, etc., that largely hide the underlying, nearly horizontal sediments. Though essentially a farming region, the portion of the country lying between Lakes Huron and Erie supports valuable petroleum, gas, and salt industries.

The most easterly of the three divisions of the St. Lawrence Lowlands comprises the portion lying east of the spur of crystalline rocks crossing the St. Lawrence below Kingston. Its northern boundary is, in general, marked by an abrupt rise of the Laurentian hills, while on the eastern side lies the hilly, semi-mountainous Appalachian

[1] Adapted from G. A. Young, *A Descriptive Sketch of the Geology and Economic Minerals of Canada*, Department of Mines, Geological Survey Branch No. 1085, pp. 60–61.

tract. Within this roughly triangular area, the land nowhere rises more than 500 feet above the sea, and below Montreal the districts immediately bordering the St. Lawrence have a general elevation of less than 100 feet, and, save in the case of a few isolated, abruptly rising hills, of igneous origin, the lowlands on either side of the river never rise to 300 feet above sea level.

The second division of the St. Lawrence Lowlands fronts on Lake Ontario, forming a plain-like area that at first usually rises rather abruptly from the lake (itself 246 feet above the sea) and then stretches inland with gradually increasing heights, sometimes reaching 850 feet above the sea. This area, comparatively narrow in the east, is bounded on the north by a marked escarpment, with a drop along its northerly facing slope of between 50 and 100 feet. Westward the district is limited by the Niagara escarpment, which runs in a northwesterly direction from the Niagara peninsula through the Indian peninsula separating Lake Huron and Georgian Bay, and is continued westerly into Michigan by the northward facing cliffs of the Manitoulin Islands.

The Niagara escarpment, the natural dividing line between the two western divisions of the St. Lawrence Lowlands, presents a general abrupt rise of 250 to 300 feet. In the Niagara peninsula this amount represents the total rise of the country to the level of the third and westernmost division of the lowlands, but farther northwest the escarpment, though still a distinct feature, is only part of a narrow strip of rapidly rising ground, whose summit reaches in places an elevation of 1,700 feet, nearly a thousand feet above the low, flat-lying country stretching easterly from its foot toward Lake Ontario. The third division, lying between Lake Huron and Lake Erie, and bounded on the east by the Niagara escarpment, has, in the northwest, as already implied, a maximum elevation of 1,700 feet or more, from which point the surface slopes toward the level of the lakes on either side, the waters of Lake Huron standing at 581 feet, and those of Lake Erie at 572 feet above the sea.

2. THE PROVINCE OF QUEBEC[1]

The Province of Quebec might with accuracy be included among the Maritime Provinces, for the Gulf of St. Lawrence is really a part

[1] Adapted from Watson Griffin, *Canada the Country of the Twentieth Century*, pp. 65, 70–72.

of the Atlantic and salt water washes the sinuous coasts of the province for many miles. The influence of the tide is felt in the St. Lawrence River at the port of Three Rivers, 900 miles from Belle Isle, and although the great blue river is estimated to pour two million gallons of fresh water into the Gulf every minute, the water is salt at St. Thomas, about thirty-six miles below Quebec City, and at Kamouraska, about forty miles farther down, salt was manufactured from the water by evaporation during the French régime. In addition, the territory of Ungava which has recently been added to Quebec Province has a very long coast line on Hudson Bay, Hudson Strait, and Ungava Bay.

Before Ungava was placed under the jurisdiction of Quebec the area of the province was 351,873 square miles. Now it is 703,653 square miles almost double its former area. Including Ungava, Quebec Province is larger than Belgium, Holland, Germany, Denmark, Sweden, Austria-Hungary, and Bulgaria combined, which had a population of over 140,000,000 before the great war began. Without Ungava, Quebec is as large as Germany, Holland, Belgium, and Italy combined.

The St. Lawrence River. The St. Lawrence from the Gulf to Traverse is from ten to thirty-five miles wide and very deep. It is skirted on the north by the Laurentian Mountains, which rise in some places near the shore to heights of over 2,500 feet, and on the south by the Northern Appalachians, whose peaks attain a height of nearly four thousand feet within a few miles of the river.

Farming in Quebec. The section of the province bordering on the Lower St. Lawrence, partly owing to its mountainous character and partly to the influence of the Arctic current, flowing through Belle Isle, has a rather severe climate and is not generally well suited to agriculture. The mainland northeast of Anticosti Island is little better than Labrador. Anticosti itself is believed to possess considerable areas of good land. West of that the climate is better and there is a good deal of fertile land in the valleys. The islands in the river west of Anticosti are all fertile.

The best agricultural region of the province is the fertile valley extending on both sides of the St. Lawrence River from Montreal to Quebec City and reaching as far east as Kamouraska on the south shore, with an area about the same as that of Holland. The greater part of the present population of the province is concentrated in this

valley. Throughout the St. Lawrence Valley apples, pears, plums and cherries are grown, while grapes are produced in the open air at L'Islet, on the south shore of the St. Lawrence, 70 miles northeast of Quebec City. Large quantities of strawberries, currants, gooseberries, and other small fruits are produced. It was once a great wheat region, but comparatively little wheat is grown now. Great quantities of oats, hay clover, and potatoes are produced, and a considerable acreage is devoted to barley, buckwheat, rye, Indian corn, peas and beans. A small quantity of flax is grown. Nearly every farmer in Quebec Province grows a little tobacco and there are a few large plantations. About ten million pounds of tobacco are grown annually in this province.

A large proportion of the farms have groves of sugar maple trees and considerable quantities of maple sugar are produced, the sap flowing freely in the early spring when there is frost at night and bright sunshine during the day.

The Province of Quebec has achieved marked success in dairying and there is room for great expansion of this industry. Good grazing land, watered by springs, streams, and lakes, abounds almost everywhere from Lake St. Francis to the extremity of Gaspé. It is not and never can be ranch country; the snow lies too deep in winter, but the nearness to the markets of Europe as well as to those of industrial Canada largely offset the cost of winter feeding and housing. Dairy farming is now attracting special attention, and in the district between the St. Lawrence River and the United States boundary, commonly known as the Eastern Townships, there are already many fine herds of cattle with some of the best blood in America. Quebec ranks second among the provinces of the Dominion in the production of butter, cheese, and condensed milk.

The farms of Quebec Province are generally long, narrow strips of land, frequently having a frontage on some river road with houses and outbuildings near the river banks, so that the farmhouses stretch for miles along the rivers, looking almost like continuous villages and just as the rivers of the province here and there spread out into lakes, so these straggling farm villages at certain points expand and become towns with varied industries.

The Forests of Quebec. Estimates regarding the extent of the forest resources of Quebec do not include the newly added territory

of Ungava, but it is not considered that the forests of that territory are very extensive. The forestry experts of the Quebec government estimate that the forests of the old Province of Quebec contain 50,000,000,000 feet board measure of white and red pine, 125,000,000,-000 feet of spruce and balsam fir, 100,000,000,000 feet of pulp wood and 35,000,000,000 feet of hard wood, birch, maple, etc., 20,000,-000,000 feet of cedar, a total of 330,000,000,000 feet board measure. The cut of spruce exceeds that of all other woods. Next in order come white pine, hemlock, birch, and balsam fir.

3. THE ISOLATION OF THE LOWER ST. LAWRENCE VALLEY[1]

In the Lower St. Lawrence Valley is established a civilization unique in its lack of progressiveness and picturesque in its proud adherence to the ancient customs of ancestral founders. The wooded mountains showing the valley, the steep cliffs which rise, at places straight up from the river bank, the comparative inaccessibility of lowland available for agriculture, the scarcity of good harbors from the Gulf to Quebec—all are natural factors which have combined to isolate the inhabitants from the rest of the world and even to a surprising degree from one another.

Here, on strips of land or in little towns by the shore, the French Canadian engages in primitive but thrifty husbandry. Modern education has penetrated the region but slightly. The people have preserved the traditions brought overseas from France and have developed a provincialism which has recognized throughout the years no law of conqueror and no control save that of the Catholic church and which is at present serenely withstanding the censure of more belligerent peoples.

The Lower St. Lawrence Valley may be thought of as extending from the Isle d'Orléans, just below Quebec, to the relative restriction of the river between Cap des Monts on the north shore and Cap Chat on the south shore. In the three hundred miles of its length the estuary widens from two to forty miles, which is a prominent factor in giving each shore certain physical and economic distinctions.

[1] Adapted by permission from Roderick Peattie, "The Isolation of the Lower St. Lawrence Valley," *Geographical Review*, February, 1918, pp. 102–18. Mr. Peattie is assistant professor of geography, Ohio State University.

The north shore is characterized by a bold escarpment 1,500 to 2,000 feet in height, the crest of which is the southern boundary of the great Laurentian upland. Set back perhaps a mile from the edge of the escarpment are low, rounded mountains, the Laurentides, rising 500 to 1,500 feet above the upland. The upland itself dips gently northward; its undulating, tree-covered surface extends mile upon mile with amazing lack of striking forms of relief.

There are few settlements upon the upland. For the most part, forest wilderness comes unbroken to the escarpment, and in places the trees crowd down the steep slope to the water's very edge. Some of the community groups so infrequently scattered over this country of rugged solitude lie at the mouths of tributary stream valleys, others on terraces that lie at the base of the cliff. Wedge-shaped rift valleys penetrating the highlands offer sites for farming communities, and even the margin of the highland boasts settlements. Generally the upland has too meager a soil for agriculture, but where the Laurentides have stood as a protection against more severe glacial erosion the soil is deep. The coastal terraces, particularly the lowest, are of primary importance as settlement sites. These terraces are mantled with rich marine soils.

Bounding the south shore is another highland. From elevations of 1,000 feet opposite Quebec, it grows into mountains 3,000 feet in height as it nears the Gaspé Peninsula. Like that on the north, this upland is a rolling, infertile woodland plain, farmed only at the edge for the most part; but instead of terminating in a cliff, it descends gradually to the lowland. Although it lies 30 miles inland at the western end of the valley it approaches the river 100 miles down stream. From that point it follows the shore more closely, in most places grading down to the level of the water by a series of broad terraces.

These terraces are fertile, though for various reasons not always well drained. The lowest, as is the case on the north shore, is of recent emerged estuarine silt. The soil of the lower terraces, and in the western end of the valley of all the terraces, is marine and very productive.

The climate is of an extreme continental character on a leeward coast in a belt of prevailing westerlies. Herbertson has called it the Laurentian type and compares it with the similar climate of the Amur district. There are within the region two slightly different

types. The seaward portion has an appreciable marine influence, to which is added the effect of an increase in latitude by the northeast trend of the river. Generally speaking the winter is long and cold and the summer is short and warm. The precipitation is not heavy. The result is a natural vegetation of the northern conifer type, principally of spruce, fir, and pine. Hardwoods are also abundant. The snow lies on the ground until May, but once it is melted the spring blooms suddenly. The growing season has a maximum of 150 days and is usually considerably less, but the summer day is long and the rainfall not too heavy, so that grains will mature. Maize is not grown, and the frost-free period is too short for the larger fruits in the greater part of the area. The heavy snow, averaging 120 inches in depth, supplies a roadbed for logging in winter and water for the spring "runs." For five months of the year Quebec is a closed port, and the river is dangerous for at least one month more.

Such are the physical conditions of the valley. A few of the economic responses which result from these will now be described. The region has terraces and lowlands in which life never has been meager. Wood products and, recently, farm products have furnished the foundation for a healthy commerce. But the primitive economy of the hinterlands on each flank, the imperfect communication, and the lack of doorways by which one may enter the territory have been formidable barriers to cultural exchange.

The farm products of the north shore are grains, hay, vegetables, and tobacco for home consumption. The one "money crop" is cheese—a recent development. This statement does not apply to Côte de Beaupré, where milk, butter, and vegetables are furnished to the Quebec market. No village or hamlet is without the log-products industry. There are extensive lumber, pulp-wood, and pulp mills on the larger streams, and no settlement is too small to support some industry dependent upon the forest and the water-power. It may but be a small water-run mill for crude lumber or a commerce in cord wood.

The water-power is furnished by every stream in greater or less degree as it tumbles down from the upland. The Côte de Beaupré alone is served by a railroad. Beyond, the uplands come to the river's edge and present a cliff 1,500 feet high for 30 miles. At the base of this cliff a railroad bed has been blasted as far as Malbaie and will

be continued to the Saguenay. The other communities are now reached for the most part by boat. As far as the Saguenay the boat service from Quebec is regular through the summer months.

There is no farming and but one large stream between St. Siméon and Les Bergeronnes; hence there are no settlements except Tadousac, which is a resort and the point of transfer for the Saguenay River. From Les Bergeronnes to Mille Vaches there are streams which bring down timber and furnish power for its reduction. The climate and the peaty variety of much of the soil make farming a precarious pursuit. Beyond Mille Vaches there are no roads and scarcely a farm. In the remaining 100 miles there are half a dozen settlements deserving the name of town, and these are supported largely by fishing.

The south shore has much rich lowland, and, moreover, it is continuous, so that there is good rail communication. It is primarily a farming district, though in the aggregate the industries are not unimportant. The climate is somewhat milder than on the north shore, and, owing to the favorable topography and the good land communication, the farmer may consider himself possessed of advantages over his fellows upon the other side of the river. The Intercolonial Railway parallels the coast from Quebec to Mont Joli, and a small line continues to Matane. Butter, cheese, and live stock are sold according as the distance from Quebec becomes greater. Vegetables, particularly potatoes, and ellgrass (*Zostera marina*), for upholstering automobile seats, are other "money getters." The region has a fine active commerce through Quebec, but cultural contact in other directions is practically nil.

The industry upon the south shore is not extensive enough to do more than mitigate the isolation. The farming centers are small towns from ten to twenty miles apart. None of these are large even when they contain factories. The industry is usually some form of woodworking such as the production of lumber, pulp wood, furniture, or wagons. The large mills are located at Ste. Anne de la Poucatière, St. Pâcome, Rivière du Loup, Bic, Tobin, Rimouski, Priceville, and Matane. Generally speaking, the greater the distance from Quebec, the less finished is the article produced.

Strangely enough, though the Lower St. Lawrence is one of the great commercial estuaries of the world, the region has, as a whole,

poor or imperfect water communication. The reasons are these: First, there is the significant climatic fact, already mentioned, that Quebec is a closed port five months in the year and a dangerous one for at least another month. Second, the region lacks good harbors—especially upon the south shore. The coast is much indented, but the present physiographic condition of the estuary is one of emergence of a confined delta, so that the approach to the shore is always shallow. Father Point, near Rimouski, and Rivière du Loup form partial exceptions to this condition, but much of the huge output of lumber from Matane is taken out to ships by means of lighters, and Rimouski sends its lumber out over a harbor that at low tide is dry for two miles from the shore. The north shore with the exception of Tadousac has no natural harbors for large craft. The boats land at piers which are not always near the town and are frequently useless at low tide. Baie St. Paul and Murray Bay are huge indentations guarded by rugged capes, but the recent uplift and the constant filling by streams has created tidal flats of from one to three miles over which only the smaller type of schooner can float at high tide. The distance from the farming centers to the docks, and the irregularity and inconvenience of the boat service, are discouraging features of communication. Beyond the Côte de Beaupré the bulk of the freight can be moved only in summer, for in winter the only communication is by small ferries that run across to the south shore. Because of these difficulties the north shore still preserves a large measure of independence.

The language of French Canada is its most striking feature. It is a speech which has more semblance to the speech of Normandy and Picardy in the sixteenth century than to the language of Paris today. For example *-oir* has the pronunciation of an open *e*, which in France is archaic. Their old legends carry words in ancient forms, as, for example, the preservation of an *s* in *notre* instead of the circumflex. These are but casual allusions; to do the matter justice would require an article in itself. Many of the words in use by the *habitant* of today have a different meaning from the same words as used in France. These are examples of differentiation rather than crystallization. Not a few words are due to the physical or cultural environment, as *alright*, *mail*, and the verbs *mailê*, *canoe*, *beatê* (for beaten). Semple tells us that the *habitant* is so accustomed to the canoe and

its phraseology that he "disembarks" from his horse and "moors" it to a tree. One is hailed with *benevenu* as he enters a cabin.

Another element of the French Canadian which illustrates crystallization and in a most significant manner is his mental attitude. He exhibits a simple faith which exceeds that of all his contemporaries in other portions of the American continent and to many is absolutely unknown. The beginning and the end of the *habitant's* thought lies in the church. The grammar school, the college, and the newspaper turn to the church to learn the limits beyond which their intellectual advance must not proceed. From youth to old age the church's influence is constantly felt. The Mass is the one event powerful enough to bring the entire population together, and there is scarcely a storm which can keep the farmer, however remote his home, from attending it. The *habitant* is medieval in his superstitions and absolute in his faith. Let the pile of crutches at the shrine of Ste. Anne de Beaupré bear witness. I have spoken elsewhere of the effect of this isolation upon morals. The church, aided by the encompassing hills, has brought to these people a peace of conscience and a moral sense which are sublime. Nowhere else have I seen such temperance and orderliness of life.

There still exists here a modified feudalism, a survival of the seigniorial system. In Charlevoix County (Les Eboulements and Malbiae), upon the north shore, and in a number of counties upon the south the land is held by a *seigneur* who may extract a fee from the *rentier*. He has full title vested in him by an ancient and royal grant, but today the rent that he may charge is regulated by law. The limit varies and may be as low as one-tenth of one per cent of the assessed value of the farm. M. Audet of Les Eboulements explained to me that the rent on his modest *pension* and the adjoining blacksmith shop was six dollars and a chicken annually, though recently the chicken had been "abolished." Today his *seigneur* rides over the estate upon a fine horse, and the peasantry stand beside the road to doff their hats. Beyond tradition and the modest fee this man has no rights of civil jurisdiction. The *habitant* may buy the land and frequently does, though because of centuries of occupation by the same family it is already virtually his. This buying up of land, together with hostile legislation, tends to do away with the un-American archaism of feudal observances.

There are a host of other evidences of this ancient and little-modified civilization. In the older houses the architecture is distinctly Norman, and when houses are rebuilt it is often along traditional lines. Barns were being re-thatched in the summer of 1916 in the Gouffre Valley. The corbeled second story so popular in Normandy is a common sight. Windmills of ancient wooden types are used throughout the south shore and upon islands exposed to the strong southwesterly winds blowing down the estuary. These clumsy mills are used mainly for threshing the grain but also for grinding it. At Trois Pistoles I found a modern barn to which was attached this old-fashioned contrivance. Within a mile of this barn men were building a shed over a newly constructed Old World oven such as is to be found on every estate in the region—this, too, in spite of the fact that there was in the house a modern range containing an oven. This reluctance to give up old customs, or to introduce innovations in a community where all have customs so much in common, is a characteristic and highly important indication. On Isle aux Coudres, which is monotonously flat once you have ascended the twenty-foot terrace, the carts are two-wheeled. This is a relic of the days when a Norman wheel tax made two wheels more economical than four. It is asserted by the loyal *habitant* that two wheels are better for certain sorts of rough road; but as a matter of fact the roads are not rough, and the conditions are the same as on the mainland of the south shore where the farmer uses four-wheeled carts to advantage.

4. FRENCH CANADA[1]

It has been said that the privileges which the Catholic church enjoyed in the France of the old régime were conferred upon her as a reward for services against the barbarians. The same may be said of the Catholic church in Quebec, only that the barbarians in this case are the English. From the time of the conquest to the time of Papineau's rebellion competent observers believed that the French-Canadians would lose their nationality. Tocqueville, when he visited America in the early thirties, regarded them as "the wreck

[1] Adapted from E. M. Sait, "Theocratic Quebec," *Annals of the American Academy of Political and Social Science*, XLV (January, 1913), 69–72. Mr. Sait is assistant professor of politics, Columbia University.

of an old people lost in the flood of a new nation." We are told that Garneau, as he "heard the dull booming of the rising tide of the Anglo-Saxon race," wondered if his history of Canada were not after all a funeral oration. That the prophets have been confounded, that the French-Canadians have remained French and clung to the language which they brought from their Norman and Breton homes, is largely the result of clerical leadership.

After the conquest the church became the natural leader of the people. Now that the military and civil officials, the merchants and capitalists, had returned to France, the peasants had nowhere else to look for guidance. Poor, illiterate, altogether untrained in the conduct of public affairs, they confided their future to men who were accustomed to wield authority and to exact obedience and who had every reason to oppose Anglicizing influences. The Catholic clergy were anxious to keep the peasants free from contact with the Protestant English. It was in this way that the peculiarly intimate alliance between clergy and people came about, destined to leave a deep impress upon the institutions and literature of the country. Patriotism and religion were joined together.

Before inquiring what the church has done to justify her assumption of leadership, something must be said of the numerical increase and the distribution of the French-Canadians. Without some knowledge of their phenomenal development it is impossible to appreciate the practical value of clerical leadership or to understand the gratitude of the people and the tangible form which that gratitude has taken. In 1765 there were, within the present boundaries of Canada, less than 80,000 Frenchmen, descendents of the six thousand settlers who came from the mother country during the century and a half of the old régime. They were a conquered people, deprived of their leaders and without material resources. Since that time they have received no accession of strength from immigration; in the whole of Canada there were less than eight thousand "Français de France" at the opening of this century. Nevertheless, the handful of peasants have increased to more than three millions.[1] Dominant in the Province of Quebec, where they constitute 80 per cent

[1] The figures given here are based upon the Canadian census of 1901, as the tables showing the distribution of races under the last census are not yet available. [In 1911, people of French origin numbered 2,054,890, or 28.51 per cent of the total population of Canada.]

of the population (1,322,155 in 1901), they have thrust themselves westward into Ontario, where they control several border counties; eastward to join the resurgent Acadians who now form a quarter of the population of New Brunswick and more than half the population of the six northern counties of that province; and southward into New England where, drawn by economic forces which have now ceased to be operative, they settled in the factory towns, and now form something like a fifth of the population of Vermont, New Hampshire, and Rhode Island. Careful estimates have shown that there are a million and a half French-Canadians in the United States. But, scattered among a rapidly-increasing population of different origin and no longer fortified by new blood from Quebec, there is little chance of their persistence as a separate nationality even in those parts of New England where they are most numerous.

It is in the cradle of the race, upon the banks of the St. Lawrence, that the hope of the future lies. Quebec is not an English-speaking province and presumably never will be. Nowhere else, in Canada or the United States, is there a people who can so fairly claim to be autochthonous. The French-Canadians, whose blood runs substantially pure and whose language is more nearly that of the seventeenth century than is the language of modern France, have built up in the last three centuries one of the vital resources of a people, a history of which they are proud. They cherish the days of Frontenac and La Galissionnière, of Bréboeuf and Daulac des Ormeaux, in a peculiarly intimate way. Those who know the songs they sing and the literature they have produced will understand how deep their love of the soil goes. All that has happened in Quebec since its cession to the English seems to indicate that assimilation will never take place. Sheltered behind a national organization which has called to its service religion, education, language, literature and national societies, and which is everywhere informed by a deep consciousness of race, the French-Canadians have preserved their distinctive characteristics and have contested successfully with their conquerors for possession of the soil. In the second half of the nineteenth century the English element declined from 25 to 20 per cent of the population. In five counties an English population does not exist; in a score of others it falls below 5 per cent, usually well below. In the country districts the tendency has been for the English majorities, where such existed,

to become minorities and sink gradually into insignificance. "The danger of assimilation has completely disappeared," says M. Thomas Côté; "we are the masters of our destinies." The process by which the English have been supplanted upon the soil is best exemplified by the history of the Eastern Townships, the eleven counties which lie between Montreal and the American frontier and which were originally settled by immigrants from Great Britain and the United States. By 1851 the French had become a third of the population of the Townships; by 1861 nearly a half; by 1901 two-thirds. In many an old English center all that remains to show the past is a ruined Protestant church and an overgrown graveyard. If the present tendencies continue, the soil of the Townships will pass entirely to the invader.

What has brought about this movement? Aside from the superior fecundity of the French-Canadians (there is an authentic case of thirty-six children in a family), it cannot be ascribed to their superior energy. Those who know the obstinate conservatism and routine methods of the *habitant* would scout the idea. The truth is that the displacement was voluntary at first, the English-speaking farmer going elsewhere to better his condition, and was afterward enforced; and it was enforced, not by any survival of the fittest, but by the organization and activity of the Roman Catholic church. In fact, the church is the main factor in rooting the *habitant* to the soil and keeping him there. Her clearly developed plan, as the *curé* tells his flock in the country parishes, is to make the English and Protestant parts of the province Catholic and French. Colonization societies, in which the clerical element predominates, give assistance to poor colonists, contribute to the cost of churches and schools, and open up new roads. They act as bureaus of information. They know of every farm which has been offered for sale and have one of the faithful ready to occupy it. Behind the church stands the government, subsidizing the societies and contributing to the cause in other ways. The Papal Zouaves were rewarded with a block of township land.

In each locality the same thing happens. One by one the English families leave. One by one, directed by the church, the French families arrive. Finally a time comes when the English, losing their predominance, feel the pressure of the invasion. Left more and

more in the minority, they find it hard, then actually impossible, to maintain the one Protestant church which ministers to the various denominations. The children, playing with French children, are in danger of becoming French. Thus the retreat, which was gradual and voluntary at first, finally develops into a frightened rout. Those who remain behind become, like the Highlanders of the county of Charlevoix, French in everything but name. From all parts of the province the English have been converging on the island of Montreal. In the twenty years preceding the census of 1901, although their increase for the province was only 41,500, they added 38,700 to the population of the city alone. To the population of the whole island, which is becoming more and more a mere suburb of the city, they added over 60,000—at the expense, of course, of other English districts. As long as conditions are unaltered this movement will continue. Only in Montreal have the English a position of apparent security and permanence. It is a curious situation. Perhaps in defending Montreal they feel unconsciously that they are defending the last ditch.

5. THE PROVINCE OF ONTARIO[1]

The province of Ontario is the section of the Dominion lying between the great international lakes and Hudson Bay. It extends from the western boundary of Quebec to the eastern boundary of Manitoba, and has an area of 365,888 square miles of land and 41,382 square miles of water, a total of 407,262 square miles. A territory as large as the American states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Maryland, Pennsylvania, West Virginia, Ohio, Indiana, and Michigan might be cut out of its land area and there would be still some thousands of miles to spare. It is nearly as large as Germany and France combined.

The shape of Ontario is somewhat similar to that of Italy, with the foot of the boot in the Great Lakes, just as the Italian boot extends into the Mediterranean, but instead of the Adriatic Sea, Ontario has the Ottawa River on its eastern boundary.

The southern part of the province is in nearly the same latitude as Italy, Pelee Island in Lake Erie being almost as far south as Rome,

[1] Adapted from Watson Griffin, *Canada the Country of the Twentieth Century*, pp. 95–99.

while Hamilton is in about the same latitude as the French port of Marseilles. Moose Factory, the Hudson's Bay Company post on James Bay, at the confluence of the Moose and Abitibi rivers, is in latitude N. 51° 16′, a little farther south than London, England, the world's metropolis being in latitude 51° 29′.

Through the province from Lake Abitibi to Lake St. Joseph runs the elevated belt known as the height of land, from 1,000 to 1,500 feet above sea-level, an extension of the highland belt of Quebec Province. On the southern slope of the height of land are the sources of the rivers which empty into the Great Lakes and the St. Lawrence River, while those flowing into Hudson Bay rise on its northern slope.

The population of Ontario was 2,523,274 according to the census of 1911 and about 94 per cent of the people are concentrated within the peninsula lying to the south of a line drawn from the northeast corner of Georgian Bay, through Lake Nipissing to the Ottawa River. This peninsula has an area of 51,150 square miles without including the surrounding waters, which is about the same size as England, with an area of 50,200 square miles. This district is sometimes called Old Ontario, sometimes Southern Ontario, while the remainder of the province is known as New Ontario or Northern Ontario.

Nearly the whole of Old Ontario is fertile, although in some of the southeastern counties as well as in the counties of Muskoka, Parry Sound, and Nipissing there are considerable areas more suitable for forest reservations than for farm lands.

Apples and certain varieties of grapes can be grown successfully in any part of Old Ontario, but the fruit garden of the province is the southwestern peninsula, lying between Lake Erie and Georgian Bay, and bounded on the west by the Detroit River, Lake St. Clair, River St. Clair, and Lake Huron. This district rivals the Annapolis Valley of Nova Scotia in the production of apples, while peaches, pears, plums, and the finest varieties of grapes grow to perfection in the southern counties. Peaches and grapes are most extensively grown in the district between Hamilton and Niagara where there are many thousands of acres of peach orchards. The fruit-growing areas are continually extending in the southern counties of Ontario, lands formerly devoted to grain growing and general farming being planted with orchards. Ontario farmers at one time devoted their lands almost entirely to grain growing and large quantities of wheat,

oats, and barley are still produced, but grain growing has to a large extent given place to fruit growing and dairy farming. Ontario leads the world in the production of cheese. During the fourteen years ending with 1914 the average annual production of cheese was 136,047,890 pounds.

The country stretching from Lake Nipissing to the Lake of the Woods and extending from the northern shores of Georgian Bay, Lake Huron and Lake Superior to the height of land is known as the Algoma district, and has often been described by superficial observers as a worthless rocky region, which must always prove an insurmountable barrier between central Canada and the Northwest. That it looks rocky and worthless, whether viewed from a steamship or from a railway car, cannot be denied, but throughout this region are numerous little fertile valleys watered by swift flowing rivers and pretty lakes. It must be admitted that, these valleys being small, there is not much good land in any one spot, but altogether there are many areas available for cultivation between Nipissing and Port Arthur, but the greater part of this area will never be anything more than a lumbering and mining region. The fact that most of the rivers of the province have their sources on the slopes of the height of land make it desirable that it should be maintained as a forest reservation, and if the forests are properly protected they may be made to yield a large revenue to the province. In the vicinity of Port Arthur and along the Rainy River and about the Lake of the Woods there are large tracts of fertile land.

But the wealth of the Algoma district is in the rocks rather than in the soil, for there is reason to believe that it is one of the richest mineral districts of the world. Great discoveries of nickel, copper, silver and gold have already been made, and only a small part of the district has been thoroughly prospected.

The country north of the height of land is almost a complete wilderness. The Grand Trunk Pacific Railway and the Canadian Northern Railway have recently been constructed through it, but the settlement of the country has hardly begun. The Ontario Government has built a railway from North Bay, at the head of Lake Nipissing, to Cochrane, on the Grand Trunk Pacific, and settlement is extending along this railway.

6. THE ST. LAWRENCE WATERWAY[1]

The St. Lawrence system, including the gulf, lakes, river stretches, and canals, provides a continuous navigable inland waterway extending from the Strait of Belle Isle to Duluth, a distance of 2,339 statute miles from the Atlantic Ocean. The distance to Port Arthur on Thunder Bay, at the head of navigation on the Canadian side of the lake, is 2,217 statute miles, while the distance to Chicago is 2,243 statute miles. In this great waterway there are 74 miles of canals with 49 locks. From Montreal to Fort William, at the head of Canadian lake navigation, the distance is 1,214 statute miles, the distance to Chicago, 1,240 statute miles, and the distance to Duluth, 1,336 statute miles.

The Sault Ste. Marie rapids, on the St. Mary's River, between Lakes Superior and Huron, are avoided by a canal 7,067 feet in length, between the extreme ends of the entrance piers. There is one lock 900 feet by 60 feet, the depth of water at lowest known level being 18 feet but ordinarily about 20 feet. There is a similar canal on the United States side of the boundary, built by the United States government, and these waterways are popularly known as the "Soo" canals. Some of the freight boats passing through these canals are 602 feet long and 60 feet beam, with a registered tonnage of 6,000 tons net. A large percentage of the freight passing through is carried by boats of over 4,000 tons net register. As the Canadian and American Sault canals are side by side, and free to vessels of both nations, Canadian vessels sometimes use the American canal and American vessels the Canadian canal, selecting whichever is the more convenient for passage at the moment of arrival. In 1913, 15,599 vessels, having registered tonnages of 32,062,619 tons and freight tonnages of 37,022,201 tons, passed through the American canal, and 8,285 vessels, having registered tonnages of 25,974,441 tons and freight tonnages amounting to 42,699,324 tons, passed through the Canadian canal. During the same year 5,085 vessels, with tonnages amounting to 20,033,884 tons, passed through the Suez canal.

From the St. Mary's River there is deep-water navigation through Lake Huron, the St. Clair River, Lake St. Clair, the Detroit River,

[1] Adapted from Watson Griffin, *Canada the Country of the Twentieth Century* pp. 67, 85–89.

and Lake Erie.[1] The Niagara Falls are avoided by means of the Welland Canal from Port Colborne on Lake Erie to Port Dalhousie on Lake Ontario, $26\frac{3}{4}$ miles in length, with twenty-six locks. From Port Dalhousie to the foot of Lake Ontario there is deep-water navigation, but on the St. Lawrence between Lake Ontario and Montreal six canals, with an aggregate length of $46\frac{5}{12}$ miles, and twenty-two locks are necessary to avoid rapids. These canals are the Galops, $7\frac{3}{4}$ miles long with three locks; the Rapide Plat, $3\frac{2}{3}$ miles long with two locks; the Farran's Point, $1\frac{1}{2}$ miles long with one lock; the Cornwall, 11 miles long with one lock; the Soulanges, 14 miles long with five locks, and the Lachine canal, $8\frac{1}{2}$ miles long with five locks, connecting Lake St. Louis with the harbor of Montreal. The minimum dimensions of the canal locks between Lake Erie and Montreal are: length, 270 feet, width, 45 feet, depth of water on sills, 14 feet. Vessels 255 feet long can be accommodated. It will be noted that the dimensions of the canals between Lake Erie and Montreal are less than those of the Sault Ste. Marie Canal. The large lake vessels coming down from the upper lakes transfer their cargoes to the smaller vessels at Port Colborne. However, a larger canal is now being constructed between Lake Erie and Lake Ontario. According to the statement of the engineer in charge, this enlarged canal will follow the course of the present canal from Port Colborne on Lake Erie to Allanburg, half-way across the peninsula, from which point a new cutting will be made to a point on Lake Ontario to be known as Port Weller, three miles from the Ontario entrance to the present canal. The total length of the canal from lake to lake will be 25 miles, and the difference in level between the two lakes, $325\frac{1}{2}$ feet, is to be overcome by seven lift locks, each having a lift of $46\frac{1}{2}$ feet. The dimensions of the locks are to be 800 feet in length by 80 feet in width in the clear, with 30 feet of water over the mitre sills at extreme low water in the lakes. The width of the canal at the bottom will be 200 feet. For the present the canal reaches will be excavated to a

[1] [Two notable improvements were necessary before a channel deep enough for the larger lake steamers was obtained. One was a jetty to secure a deep channel through the shallow water at the delta which the St. Clair River has built at the point where it empties into Lake St. Clair. The other was a deep-water channel cut in the limestone which floors the Detroit River near its mouth. This shallow place in the Detroit River is known as the Lime Kiln Crossing and during a storm was dangerous to shipping.—C. C. C.]

depth of 25 feet only, but all structures will be sunk to the 30-foot depth, so that the canal can be deepened at any future date by the simple process of dredging at the reaches. This canal will have greater dimension than any other Canadian canal. When it is completed the largest lake vessels will be able to go from the head of Lake Superior to Kingston, near the foot of Lake Ontario, where they will have to transfer their cargoes to smaller vessels running through the St. Lawrence canals to Montreal until the St. Lawrence canals are enlarged, as they probably will be eventually.

While the St. Lawrence is 30 or more feet in depth between Montreal and Quebec there are a number of shoal places, and to enable modern ocean vessels to reach Montreal it has been necessary to dredge channels through these shoals. The longest shoal is where the river expands to form Lake St. Peter which is nine miles wide, twenty miles long, and has a general depth of from eleven to eighteen feet, with a few deep pools.

It is seventy years since the dredging of a channel through the shoals was first begun, and it did not require to be very deep to accommodate ocean-going vessels of that day, but as the size of ocean vessels has increased the channel has been deepened and widened. Now ships drawing thirty feet of water can go up to Montreal at extreme low water. The intention is to eventually have a channel nowhere less than 35 feet deep. The whole St. Lawrence Channel is splendidly equipped with buoys and lights, so that navigation is very safe.

The character of the river bottom is such that when the channel is once made it is permanent and there is no difficulty in keeping it always clean and clear.

The season of navigation on the St. Lawrence varies somewhat in different years. At Montreal, for the thirty-six years from 1879 to 1914 inclusive the earliest opening of navigation for river craft was March 31, and the latest May 5, while the earliest closing of navigation was December 2, and the latest the end of the first week in January. The earliest date for the arrival at Montreal of the first vessel from sea during the same period of thirty-six years was April 11 and the latest May 6, while the earliest date for the last departure of vessels for the sea was November 20 and the latest December 4.

CHAPTER V

THE LAURENTIAN UPLAND

1. SOME RESPONSES TO PHYSICAL ENVIRONMENT IN THE LAURENTIAN PLATEAU[1]

One of the most interesting problems for study presented by the Laurentian peneplain is the influence which the type of topography here developed has had upon the occupation and exploration of the region. Stretching as it does from the frozen arctic to the temperate regions of central Ontario, and from the ocean border on the east to the mid-continental region of the great plains on the west, in its different parts it presents many aspects indicating the operation of climatic influences which affect its flora, its fauna, and its human occupation.

The uplands of the Labrador and the far northwest region (northern Keewatin and northeast Mackenzie) are devoid of trees, the vegetation being confined to the lower orders of plants. Next southward we find the belt of conifers stretching across all the region from Hamilton Inlet to Great Slave Lake, the trees increasing in size and variety with decrease of latitude. In the central parts deciduous trees abound. Although in general throughout the region we find uniformity of features, in structure and development there is a great diversity of detail. The enormous number of lakes and streams, the widespread distribution of the forests, the general uniformity of the topography, and the climatic characteristics of the region, have all contributed to make it the home of those animals whose flesh is valuable for food, and of those whose pelts are valuable for clothing or as articles of commerce. The remarkably even character of the topography of the region, the character of the flora, and the protection offered by climatic conditions even now make possible the existence

[1] Adapted from A. W. G. Wilson, "Physiography of the Archean Areas of Canada," *Report of the Eighth International Geographic Congress* (Washington, 1905), pp. 116–34. Mr. Wilson is chief of Metalliferous Mines, Mines Branch, Department of Mines.

of those vast herds of caribou (comparable to the herds of buffalo which roamed the great plains of the West until after the advent of the destructive white man) which at the present roam over the barren grounds.

The Indian inhabitants of the region, living chiefly on the products of the chase, have here from time immemorial found their hunting-grounds. The numerous lakes and streams then, as now, were the only lines of communication in all that vast area. Their distribution through all parts of it and the comparative ease with which traverses from one body of water to the next can be made enabled these people to wander unimpeded over the whole region. The customs of these people in the several parts of the area differ but little; in language there are greater differences, but over very large areas the speech is the same. Probably nowhere else over so large an area have scattered communities retained so well their communal characteristics. In language, customs, and culture they differ greatly from the various tribes found in the mountainous districts of British Columbia. In some of the unexplored parts of the region there are Indians who have not yet seen a white man, unless perhaps some half-breed trader.

On the other hand, to the average white man, with his different modes of living, the region, with its exceedingly limited agricultural possibilities, has always been inhospitable. He has displaced the native Indian inhabitants in the fertile plain regions which border the peneplain to the south and west. The last remnants of some of these displaced tribes still survive upon these uplands, and still eke out a more or less precarious existence on the products of the chase. To the white man, however, the region offers other inducements which lead to the temporary occupation of local areas. The degradation which produced the peneplain has not only made possible the widespread forest, but has exposed mineral deposits that otherwise would not have been accessible. The region is thus of great importance as the source of almost a world's supply of timber and of the products of the mine, more particularly of the ores of iron and copper.

The character of the country makes the continued existence of the fur-bearing and game animals possible. The widespread distribution of these animals, the chief support of the inhabitants, has led to the scattering of the people over the whole area and to the development of more or less nomadic habits and customs.

The journeys of the early explorers across the region were possible because of its peculiar topographic features. These journeys were undertaken by the early missionaries almost always, and by the fur traders frequently, to visit the wandering Indians scattered throughout the region. The fur traders often undertook journeys solely for the purpose of hunting. The stories of the travels of these early missionaries told by Parkman and others, and the histories of the great fur companies, incidents of which form the historic foundation of many tales, afford some of the most fascinating chapters in the history of Canada, and in the study of the physiographic influences of this region. The early explorations of the eastern, central, and southern part of the western arm of the area were made largely by the missionaries and the employees of the great trading companies. The exploration of the Far Northwest, on the other hand, with the exception of the three years' adventurous wanderings of Hearne, an employee of the Hudson Bay Company, were only incidental to continued search for a possible northwest passage.

The climatic conditions of the Far Northwest and the absence of soil in any considerable amount from the Labrador areas and the country just north and west of Lake Superior means that these regions will always be shunned by the majority of white men in search of permanent abode. There are, however, considerable areas where there is a good soil cover, generally of fine glacial or lacustrine clays and sands, which are habitable and lie within the wheat belt. The largest of these lies between James Bay and the Lake Superior divide. Smaller areas, now partly occupied, occur in the vicinity of Lake Temiscaming and St. John. The region is, however, one of great promise in another respect. Under progressive governmental control, and under the competent supervision of trained forest engineers, it could be made an immense permanent forest reserve, a source of timber for many centuries to come. At present the timber resources are being rapidly exhausted, and practically no provision is being made for the restoration of the forests.

2. THE CLAY BELT OF NORTHERN ONTARIO AND QUEBEC[1]

One of the important discoveries of recent years in Canada has been the recognition of an agricultural district more than 30,000

[1] Adapted from John A. Dresser, "The Clay Belt of Northern Ontario and Quebec," *Journal of Geography*, XI (April, 1913), 250–55.

square miles in extent, within the Laurentian plateau or peneplain. This new district is called the Clay Belt of Northern Ontario and Quebec.

Discovery. As early as 1870, geological and other explorers called attention to land fit for agriculture along the Abitibi River and other routes of travel to James Bay. But it was thirty years later before it was realized that the land between the traveled routes is of the same general character, and that the narrow strips of tillable land to be seen from the waterways are parts of a large, compact area of agricultural land, broken only by lakes, swamps, and a few rock hills. It must be remembered that except in winter, when the ground is covered with snow, the only means of travel in this region is by canoe. And although the lakes and rivers are so numerous as to furnish a remarkable number of canoe routes, yet before the advent of the railway most of the traveling was done along a few principal routes. Consequently, much of this vast tract is even yet but little known.

However, about 1899, the reports of the Ontario Bureau of Mines pointed out the probable large extent and important value of the clay lands in this northern country. Accordingly, in 1900 as many as ten exploration parties were placed in the field, with the object of tracing out the extent of the agricultural lands of the district. From their surveys and those of the Department of Crown Lands the approximate boundaries of the Clay Belt in Ontario were made known. Later investigations have added to the information then gained and have shown partially, at least, the extent of the fertile area in adjacent parts of the Province of Quebec.

Origin. The Clay Belt is the bed of an extinct lake, perhaps once as large as Lake Superior, which covered this area in a late stage of the last great Ice Age. An ice sheet which extended southward and westward from the highlands of Labrador, covering the region of the Great Lakes, retreated northward by the melting of its southern edge. When the edge of the ice sheet passed north of the height of land between the Great Lakes and Hudson Bay, the water formed by the melting of the ice became confined between the edge of the ice sheet and the height of land. Thus a lake, or series of lakes, was formed which was finally drained when the ice sheet which held it in on the north was melted away. For this ancient lake, Professor Coleman has aptly chosen the name "Ojibway," from the principal tribe of the

Indians who are the earliest known inhabitants of the land it once covered.

The water of the lake, assorting the clay and silt from the debris of rock and earth left by the ice, deposited them in beds, thus leveling the surface and covering it by a soil that is free from stones.

General Character. The surface of this glacial lake bed is an undulating plain. The even sky line is broken only by an occasional rocky ridge or an abrupt hill formed by some old volcanic intrusion, but these are rarely, if ever, more than 300 feet above the surrounding country and are generally less than half that height.

There are many small lakes, though they are less numerous than in the rocky country south of the Clay Belt. The streams are numerous and flow more rapidly than the flat appearance of the country would lead one to expect. There are occasional rapids, and small falls which might provide water-power of local importance.

The prevailing timber is black spruce, which covers much of the lower land. Poplar and white birch generally cover the ridges, and where the soil becomes sandy, the chief timber is jack pine. The forest is broken in places by burned areas, and by swamps, in which drainage is not yet sufficient to allow trees to grow. Much of the swamp land, however, will be reclaimable when the surrounding forest has been removed.

The soil is mainly stratified clay loam often overlain by a few inches of black earth, largely of organic origin. The clay is frequently in beds of two or three inches in thickness, separated by layers of fine sand or silt less than one-fourth of an inch deep. Locally there are areas of boulder clay, but the soil is generally free from stones.

Various kinds of grain and root crops have been raised at different Hudson's Bay trading posts in the district for many years. Very promising farms have been opened along the Timiskaming & Northern Ontario Railway. Mixed farming has been very successfully carried on around the northern end of Lake Timiskaming for the past 15 or 20 years, and on a larger scale with wheat raising and dairying in the Lake St. John district for a still longer time. In this district there is a population of about 60,000 people, occupied in farming and lumbering. Accordingly the general suitability of the Clay Belt for farming purposes may be considered as well established.

Railway Development. Four railways give access to this region. The National Transcontinental Railway traverses it from east to west and the Canadian Northern parallels the Transcontinental through the western half at a general distance of 50 miles to the south. Both of these roads are parts of transcontinental systems.

The Timiskaming and Northern Ontario enters the Clay Belt from the south, near the boundary between Ontario and Quebec and joins the Transcontinental Railway at Cochrane, connecting it with Toronto and "old" Ontario and Quebec.

The fourth railway, the Algoma Central & Hudson Bay, extends from Sault Ste. Marie to the Transcontinental at the town of Hearst, with several branches to mining camps, and one to Michipicoten Harbor on Lake Superior. The Algoma Central & Hudson Bay crosses the Canadian Pacific Railway at Franz. The latter line runs nearly parallel to the southern limit of the Clay Belt and at short distance from it for 200 miles but does not enter this fertile area.

3. THE WINNIPEG, A TYPICAL RIVER OF THE LAURENTIAN UPLAND[1]

Winnipeg River is one of the most notable power rivers on the continent; it flows in a westerly direction, connecting the Lake of the Woods with Lake Winnipeg. The basin drained comprises an immense area of some 53,500 square miles. As is typical of Laurentian country, the area is dotted with innumerable muskegs and lakes, the latter varying in size from small ponds to the Lake of the Woods, with an area of 1,500 square miles. Since practically the entire basin is of Laurentian formation, containing areas of overlying soil of glacial origin, certain general characteristics apply to the drainage basin as a whole. The country is rough and hilly, with large areas of rock outcrop. This latter feature applies in the main throughout the Winnipeg River, and lends itself to a characteristic formation throughout the river channel, which is of exceptional value in the interests of power development. The larger proportion of the river bed in the province of Manitoba consists of a series of deep, cup-like basins, forming small, lake-like expanses, with little or no current. The river

[1] Adapted from Leo G. Denis, *Water-Powers of Manitoba, Saskatchewan, and Alberta*, Commission of Conservation of Canada, 1916, pp. 11–12. Mr. Denis is Hydro-Electric Engineer for the Commission of Conservation.

flow finds its way from these basins by falls and rapids over the rock formation, which is always in evidence at the outlets, and which forms both the means of egress from and the controlling feature of the basin water level. These falls form the natural power sites along the river.

A valuable timber growth, including spruce, tamarack, birch, and pine, occurs throughout the whole district. Lumbering is carried on extensively, and, in addition, pulp and paper industries have been established at Fort Frances and Dryden. Notwithstanding the great extent of rock outcrop, considerable areas are available for farming, particularly in the Whitemouth and Rainy River districts. While there are several prosperous towns in the basin, such as Fort Frances, Rainy River, and Kenora, the greater portion of the country is still unsettled.

CHAPTER VI

THE PRAIRIE PROVINCES

1. THE WESTERN PLAINS OF CANADA[1]

The part of Canada extending from the western boundary of Ontario to the Rocky Mountains and from the United States boundary to the Arctic Ocean has been known by different names in the course of its history. For a long time it was generally known as the Hudson Bay Territory, but was sometimes called Prince Rupert's Land and often referred to as the Great Lone Land. After it became part of Canada it was known for a number of years as the Canadian Northwest. In recent years it has been more frequently called Western Canada, although this name should properly include British Columbia. Perhaps the most appropriate name is the Western Plain of Canada which distinguishes it from the mountainous province of British Columbia. Politically the Western Plain has been subdivided into three Prairie Provinces, Manitoba, Saskatchewan, Alberta, and the Northwest Territories. Each of the Prairie Provinces extends from the United States boundary to the sixtieth parallel of latitude, while the Northwest Territories include the whole of the Western Plain north of the sixtieth parallel of latitude.

The Western Plain has three great river systems with lake reservoirs, the Nelson and Churchill rivers draining into Hudson Bay and the Mackenzie draining into the Arctic Ocean. The most important river of the prairie country is the Saskatchewan, which has two branches rising near together in the foothills of the mountains, but flowing in tortuous courses one south the other north and finally joining in a common channel which carries their waters to Lake Winnipeg. In the lower part of its course the Saskatchewan has a number of small lake reservoirs including among others Cumberland, Namew, Saskeram, and Cedar lakes, which receive the overflow from a number of other small lakes and rivers of the north. The most serious

[1] Adapted from Watson Griffin, *Canada the Country of the Twentieth Century*, pp. 118–29.

obstruction to navigation on the Saskatchewan is a waterfall or rapids beginning a short distance above its entrance to Lake Winnipeg. The Red River rising in the United States flows northward to Lake Winnipeg, receiving at the city of Winnipeg the winding Assiniboine, coming 450 miles from the west.

Steamers run from Winnipeg along the Red River, and through Lake Winnipeg to the rapids of the Saskatchewan, a distance of 286 miles. The construction of two or three short canals, the removal of a few boulders, and a little dredging would make it possible for steamers to run from Winnipeg to Prince Albert, Battleford, and Edmonton on the North Saskatchewan, Saskatoon on the South Saskatchewan, and Brandon on the Assiniboine. However the prairie rivers, although long, are neither wide nor deep and will never accommodate large vessels. The Nelson is a large river, but at present is only navigable for about sixty miles from its mouth owing to rapids.

Three Natural Subdivisions. The vast Western Plain, which is drained by these great systems of rivers and lakes, has three great natural subdivisions, the Prairies, the Forest Region, and the "Barren Lands." The Prairie Region lies between the United States boundary and the fifty-fourth parallel of latitude, sloping gradually eastward from an elevation of over 3,500 feet in the foothills of the Rocky Mountains to an elevation of about 800 feet in the valley of the Red River. There is also a steady slope northward, but the eastward slope is a little more pronounced and directs the course of the rivers toward Hudson Bay. Throughout the Prairie Region there are trees in many spots along the banks of rivers and on the low hills that rise from the plains in some places, but the prairie country as a whole is almost treeless except in the northern part, where there is a park-like country having many groves of trees with wide, open spaces between them. This park country may be regarded as the borderland between the Prairie and the Forest Region. The Forest Region includes the districts lying within the basins of the Churchill and Mackenzie river and lake systems and the country extending east and northeast of Lake Winnipeg to Hudson Bay. Just as in the Prairie Region there are small tree-covered areas, so in the Forest Region there are small prairies. The district known as the "Barren Lands" lies east of the watershed of rivers flowing into the Mackenzie

system of lakes and rivers and extends from about the sixtieth parallel of latitude to the Arctic Ocean. It is drained by a number of rivers flowing into Hudson Bay and by the Coppermine and Backs rivers emptying into the Arctic Ocean.

The Hudson Bay Railway. The prairie country is fast becoming a network of railways but as yet the forest belt is almost without railways. A government railway is being built from the Pas on the Saskatchewan River to Port Nelson, a distance of 418 miles, in response to a long-cherished desire of the western settlers for a short route to Europe. It is a remarkable fact that Port Nelson is nearer British ports than New York is, the distance from Port Nelson to Liverpool being 2,966 miles, as compared with 3,043 miles from New York to Liverpool. It is evident that if Hudson Bay and Hudson Strait were navigable throughout the year the whole export and import business of the Western Plain of Canada would take that route. Unfortunately the ice conditions in Hudson Strait are very unfavourable to navigation during the greater part of the year. Commander A. P. Low of the steamship "Neptune," commissioned by the Canadian government to study navigation conditions in Hudson Bay and Hudson Strait, said in his report:

"Hudson Bay and Hudson Strait do not freeze solid, but are so covered with masses of floating ice as to be practically unnavigable for at least seven months in the year. The ice does not begin to melt until well into the month of June, and is not sufficiently melted for safe nagivation with ordinary steamers until the middle of July. No ice is formed in the strait and bay sufficiently heavy to obstruct ordinary navigation until the latter part of November, but toward the close of this period there is danger from the early passage of the northern pack across the mouth of the strait and also to a much lesser degree from the ice from Fox Channel partly closing the western entrance to the strait. The period of safe navigation for ordinary iron steamships through Hudson Strait and across Hudson Bay to Port Churchill may be taken to extend from the twentieth of July to the first of November. This period might be increased without much risk by a week in the beginning of the season and by perhaps two weeks at the close."

The Climate of the Prairie Provinces. Throughout the three Prairie Provinces the sky is usually bright and the atmosphere dry, clear,

and pure. The dryness of the atmosphere makes both heat and cold more endurable. The cold is often extreme in winter, but the degree of cold is not realized until one examines the thermometer. The temperatures do not vary as much in different sections of these provinces as might be expected in such a wide extent of territory covering so many degrees of latitude. While the elevation increases as one moves westward from the Red River toward the mountains, the western country is farther from the influence of cold winds blowing from the ice in the north of Hudson Bay and Hudson Strait in the winter and spring, and this offsets the higher elevation. In Alberta the influence of the warm Chinook breezes coming through passes of the Rocky Mountains is often felt. These warm winter winds melt the snow in a marvelously short time, so that it seldom lies long on the ground and cattle are able to feed on the prairie all winter. Comparing Manitoba and Alberta, it may be said that the winters are a little colder and steadier in Manitoba and the summers a little warmer, but the difference is not great. Saskatchewan has very much the same climate as Manitoba and in both of these provinces the winters are less changeable than in Alberta.

The Coming of the Spring. The spring flowers and the buds of deciduous trees appear as early north of Great Slave Lake as at Winnipeg or St. Paul and earlier along the Peace and Liard rivers and some of the minor affluents of the great Mackenzie River. It is said that the spring begins in the Peace River district and advances southeast at the rate of 250 miles per day, and that winter begins in Manitoba and goes northwestward at the same rate. Many reasons have been assigned for the warm summers in the far northwest. The elevation of the country is thousands of feet lower than at the United States boundary. The British Columbia mountains are much lower at the north, and there are many passes in them through which come warm winds from the Pacific, and in the summer there is almost no night there.

Farming in Northeastern Manitoba. It will be noted that the far northwest, owing to local influences, is warmer than the far northeast in the same latitude, but the long summer days and the brilliant winter nights are common to both sections. The part of Manitoba northeast of Lake Winnipeg is almost without inhabitants excepting

hunters and fur traders. There are no farmers and consequently the agricultural capabilities of the country cannot be judged by actual results excepting what may be seen in the gardens of Hudson Bay posts where peas, beans, barley, oats, potatoes, turnips, radishes, carrots, and cabbages are successfully grown. Black currants, red currants, and gooseberries grow wild in great profusion. Wild cherries are often seen. Explorers with scientific knowledge of soils who have examined the country as carefully as possible during hurried trips across its vast expanse have reported that there are great areas of good agricultural lands, and that the country being well watered and having luxuriant grasses is well adapted to mixed farming, especially dairying, but that much of the land will require drainage before it can be utilized. It is not probable that much wheat will ever be grown northeast of Lake Winnipeg, but if butter, cheese, eggs, meats, and vegetables are produced there in large quantities it will be just as advantageous to Canada as if wheat were largely grown.

The Great Hard Wheat Belt. There is land enough in the great hard wheat belt of the prairie country west of the Red River and Lake Winnipeg to produce a large proportion of the world's present demand. Nearly the whole area of these vast prairies is suitable for wheat growing. Scientific agriculturists say that this is the largest continuous expanse of rich soil on the American continent. In addition to a rich top soil there is a deep subsoil containing great stores of nitrogen, phosphoric acid, and potash, so that without the use of fertilizers many crops can be taken off the land in succession, although they point out that even such fertility would be exhausted in course of time if the farmers continued to grow nothing but wheat as many of them are doing. However, mixed farming with rotation of crops is becoming more general. It has been pointed out that many of the settlers have not sufficient capital in the first place to buy live stock or erect buildings suitable for the winter housing of a large number of animals. Wheat farming is easy, and long before the soil is exhausted by continued recropping most of them have acquired sufficient capital to buy live stock and erect buildings. In the Province of Manitoba during a period of fourteen years about thirty-six million dollars have been expended on farm buildings, and a great part of this expenditure represents profits in wheat growing.

2. TOPOGRAPHY OF THE INTERIOR PLAIN OF CANADA[1]

The Interior Continental Plain embraces a large tract of comparatively level, rolling country lying between the Laurentian Plateau region on the east, and the Cordilleran Mountain system on the west. Along the forty-ninth parallel, here constituting the southern boundary of Canada, the plain has a width of about 800 miles, but it is reduced to less than 400 miles on the fifty-sixth parallel, and may be said to terminate on the shores of Great Bear Lake, on the sixty-fifth parallel.

The southern portion of this region includes the wide prairie country of Western Canada, extending in Alberta nearly 400 miles north of the international boundary, and including an area of above 150,000 square miles of open grass land, bordered on the north by a strip of mixed prairie and woodland. To the north the country, except locally, is at first wooded, but farther north is occupied by gradually thinning forests.

The whole of the interior plain, save a very narrow strip of about 12,000 square miles in southern Alberta and Saskatchewan, drains northward to the Arctic Ocean or eastward to Hudson Bay, and the general slope of the land is, therefore, eastward or northeastward from the Rocky Mountains to the edge of the Laurentian Plateau. A line drawn from the base of the mountains near the forty-ninth parallel to Lake Winnipeg shows an average descent of over five feet to the mile, fully accounting for the rapid courses of the rivers of the region and, in many instances, their deeply trenched valleys.

There are in the area south of the fifty-fourth parallel two lines of escarpment or more abrupt slopes, which divide this portion of the plains into three parts. The first, or lower prairie level, is that of the Red River valley and the Winnipeg system of lakes. Its average elevation is about 800 feet above the sea, and to the south of Lake Winnipeg it comprises some 7,000 square miles of prairie land, appearing to the eye absolutely flat, although rising uniformly to the east and west. The plain is bounded on the west by the Manitoba escarpment, a remarkable series of highlands, extending over 300 miles northwest from the International Boundary. The summits of this

[1] Adapted from G. A. Young, *A Descriptive Sketch of the Geology and Economic minerals of Canada*, Department of Mines, Geological Survey Branch No. 1085, pp. 107–8.

escarpment, broken through by wide valleys cut by the eastward flowing rivers, rise from 500 to 1,000 feet, or more, above the low plain to the east, once the bed of the glacial Lake Agassiz.

From the Manitoba escarpment, the second prairie level stretches westward for 250 miles to a second escarpment, the Missouri côteau that extends to the northwest, nearly parallel to the first escarpment. The second prairie level has an average elevation of about 1,600 feet, and its surface is diversified by gentle undulations and low hills rising a few hundred feet above the general level, while the river valleys are often deeply cut and wide.

The Missouri côteau, with a fairly abrupt rise of 200 feet to 500 feet, forms the eastern boundary of the third prairie level, which stretches to the foot of the Rocky Mountains. The third level has a general elevation of 2,000 feet to 2,500 feet along its eastern margin, but rises to over 4,000 feet along the borders of the mountains in the west. Its surface is much more irregular than that of the other levels, with table-lands, like the Cypress Hills and Wood Mountain, rising 1,000 to 2,000 feet above the general level, and representing the outlying remnants of a once higher plain, since largely destroyed by erosion.

The region of the Interior Continental plain has had a comparatively peaceful history since early geological times, having been left almost undisturbed by mountain-building processes, or by the intrusion of igneous bodies, and affected only by continental movements. The country is largely mantled by superficial deposits of glacial drift, concealing, over wide areas, the underlying, gently dipping, very broadly folded, stratified beds, that, in their turn, doubtless rest on the westward extension of the rocks of the Laurentian Plateau.

3. FORESTS OF THE PRAIRIE PROVINCES[1]

The provinces of Manitoba, Saskatchewan, and Alberta are frequently styled the "Prairie Provinces." While possibly the prairies may be regarded as their outstanding feature, the term is rather misleading in that it suggests the greater area to be prairie, whereas these prairies, however extensive, occupy only a small percentage of

[1] Adapted from F. H. Kitto, *The New Manitoba District*, Natural Resources Branch, Department of the Interior, 1918, pp. 25-26, and F. H. Kitto, *The Province of Saskatchewan*, Department of the Interior, 1919, pp. 105-8.

the total area of the provinces. At least 75 per cent of the entire land surface of Manitoba is covered by forests. The entire central and northern parts of the province are still practically unbroken forests. In Saskatchewan, forests occupy the northern three-fifths of the province, their southern margin being approximately the valley of the North Saskatchewan River. The southeastern one-fourth of Alberta is semi-arid grassland; the remainder is forested. In the park-like belt south of the Saskatchewan River some of the principal tracts of valuable timber have been set aside by the Dominion government as "forest reserves." Most of these are on elevated ridges or plateaus. North of the Saskatchewan River throughout the mining district of this region and extending almost to Hudson Bay the country may be described as wooded, till the "barren lands" and open shores of the bay are reached.

Though this forest area of the Prairie Provinces is very extensive, it does not represent a high average of value. The number of species is much smaller than in Eastern Canada. The hardwoods and most valuable species of soft woods are missing, while the growth of prevailing trees is generally retarded. The principal trees of northern Manitoba include only a few species, namely, spruce, white and black poplar, tamarack, birch, and jack pine. Of these, the white spruce is practically the only durable species for sawmill purposes. It grows to a fair size on high land surrounding the lakes, averaging from 18 to 24 inches in diameter. Samples up to 36 inches in diameter have been found on the shores of Reed Lake. It generally grows tall and straight, up to 90 feet in height, and makes excellent lumber, pulp, and paper. The black spruce is a slower-growing tree and does not usually reach such a size as the white spruce. It is found in low, swampy ground. Jack pine is found on nearly all dry sandy ridges. It is used extensively for ties. Tamarack grows extensively throughout the district, and is used for poles, fences, ties, and fuel. The poplars, aspens, or cottonwoods, and the birches have not yet been found of much commercial importance, but are extensively used locally as fuel.

Generally speaking, the superficial attractions of the forests of the Prairie Provinces are disappointing. A rude awakening is due the holiday seeker who goes into these woods with visions of sylvan glades and grassy slopes covered with flowers beneath the overspread-

ing branches of majestic trees. Except in the park lands of the province, where the small type of poplar predominates, the forests are monotonous and uninviting. The sandy ridges of jack pine may be traveled with a fair degree of ease but they have little else to commend themselves to the lover of nature. The rocky hills of the north present a more diversified outlook and furnish a very attractive holiday region. The areas producing the largest and most valuable, timber, chiefly spruce, are for the most part low-lying, wet, and forbidding. The muskegs of these regions rob a tramp through the woods of all its enjoyment, while the tangles of underbrush, the maze of shallow lakes, or the sluggish channels of the many streams that wind their tortuous courses through these great flat areas often make summer travel impossible. Yet the magnificent stands of white spruce found scattered all through such districts are well worth seeing, be the journey to reach them ever so trying. Winter roads are easy to construct and a certain amount of draining will imorove summer conditions.

The cut of timber in the Prairie Provinces is small. In 1918 the total value of the lumber, shingles, and lath cut was $2,200,000 in Saskatchewan, $1,260,000 in Manitoba, and $470,000 in Alberta. While these figures represent only a small fraction of the total of $113,000,000 for all Canada, nevertheless the industry has proven a boon in providing lumber and lath for local use when other sources of supply are far distant, in giving work to homesteaders during the winter months, and in opening up many new agricultural sections adjacent to the heavier woods. There are still large tracts of standing timber of good mill dimension which will guarantee several years' cut.

4. RELATION OF WATER RESOURCES TO AGRICULTURAL DEVELOPMENT IN SOUTHEASTERN ALBERTA[1]

Conservation of the waters of the Bow River is of the utmost moment, for upon it directly depends the agricultural and industrial prosperity of a very large area of southern Alberta. Rising in the high and remote regions of the Rocky Mountains National Park, and, with numerous tributaries, furnishing the most interesting and

[1] Adapted from Leo. G. Denis and T. B. Challies, *Water-Powers of Manitoba, Saskatchewan, and Alberta*, Commission of Conservation of Canada, 1916, pp. 193–206, and from Leo G. Denis and Arthur V. White, *Water-Powers of Canada*. Commission of Conservation of Canada, 1911, p. 300.

attractive feature of its world-famed scenery, the river emerges from the park only to be harnessed to supply energy for transmission to the city of Calgary for municipal purposes, street lighting, tramways, and for general commercial and industrial use. After furnishing the hydro-electric energy, the same waters have, by irrigation, converted thousands of acres of otherwise useless land into the most fertile tracts within the province.

Dual Use of Water. At first consideration it would appear that the two important uses of this water, for irrigation and for power, would result in a serious conflict of interest. Fortunately, however, irrigation requirements occur during the high-water stages of the river commencing not earlier than April 7, and extending to not later than September 30. Storage reservoirs on its upper waters would also make it possible to conserve enough of the flood flow, not required for irrigation, to compensate for the low water during the winter months, when otherwise the volume would not be sufficient for power purposes.

The present use and distribution and the future conservation of the water resources of the Bow River basin, constitute one of the most important problems before the Department of the Interior. In some of its phases this problem has already been solved, while in others it awaits solution, although a beginning has been made and the lines of practicable progress have been fairly well marked out.

General Description of River. The Bow is a typical mountain river, rising in the eastern slope of the Rocky Mountain system, west of the city of Calgary, Alberta. It drains an area of 3,138 square miles. The mountain portion of the basin—the portion above the Kananaskis fall—includes an area of 1,710 square miles. Fortunately, the mountain area is in the Rocky Mountains National Park, and enjoys all the advantages of park administration. The river has a very steep slope, and in several places falls occur, caused by outcropping ledges of sandstone. Its flow is typical of all mountain streams, subject to sudden variation, and greatly influenced by conditions of temperature. During the winter it is greatly reduced, but in June and July, rains and the melting of the glaciers cause floods, and the variation between high and low water is very great.

Water-power Producing Section. The power-producing section of the river is a stretch about 30 miles long, within easy transmission

radius of the largest power market of the district, the city of Calgary. The growth of this city has been phenomenal. As the city controls its public utilities, including street railway, water-works, electric light, etc., it is in the market for power in rapidly increasing amounts. There are, also, other large users of power, including the Canadian Pacific Railway. The first hydro-electric development on the Bow River was that of the Eau Claire Lumber Company, situated within the city limits of Calgary.

Calgary Power Company, Limited. A growing demand for hydro-electric power at Calgary resulted in the Calgary Power Company, Ltd., constructing a modern 19,500 horse-power hydro-electric plant at Horseshoe Fall, about 48 miles from the city. Owing to variation in flow, the output is not continuous. This development was commenced in 1909 and completed on the assumption that the minimum flow of the river was about 1,000 cubic feet per second. Unfortunately, in the early stages of operation it was discovered that the minimum flow was so much less than supposed that the company was, early in 1911, confronted with the immediate necessity of either constructing a steam auxiliary plant at Calgary, or of undertaking storage works at the most favorable point on the upper waters of the Bow River.

Storage Works for Winter Flow. In March, 1912, construction was commenced on a storage dam at the outlet of Lake Minnewanka, in the Rocky Mountains National Park. It was completed in time to impound the flood waters of the summer of 1912, and make them available for the winter flow of 1912–13. By the construction of this dam, about 58,000 acre-feet of water can be stored, of which 44,000 acre-feet are guaranteed to the power company.

Numerous Irrigation Propositions. Calgary lies on the western, and Regina on the eastern limit of a dry belt, in which the soil is, for the greater part, very fertile. Irrigation has been carried on in this district. The first project was constructed on Fish Creek in 1879; but it was not until 1893 that works were undertaken on an extensive scale. By the end of 1894 there were 70 systems of various sizes in operation.

Irrigation undertakings increased until, in 1902, the number of ditches in operation was 169, capable of irrigating 614,684 acres. Recently some of the projects have been abandoned.

About 1905, the Canadian Pacific Railway Company became an active advocate of irrigation, and instituted the largest and most comprehensive reclamation undertaking in the Canadian West. A main channel, with headworks just below the junction of the Bow and Elbow rivers, carries water to irrigate land to the east of Calgary. The principal undertaking is farther east, where the company has recently constructed the Bassano dam to serve 513,000 acres of irrigable land.

In designing the system, the aim was to make the maximum number possible of what are known as combination farms, that is to say farms with about an equal area of irrigable and non-irrigable land, and this idea has been carried out throughout the whole block. It should be noted that irrigable land under this system includes all land lying at a lower elevation than the point of delivery, whereas the general classification of irrigable land in other schemes comprises all that lying at a lower elevation than the distributing canal from which the water is drawn. It will be seen from this that combination farms were made quite possible, and land, which under any other system of classification would have been irrigable, is classed as non-irrigable.

The land was put on the market in 1907, and, in spite of the endeavors of the engineers to classify the land, it was necessary, early in 1909, to stop the sales until more could be classified. There is no doubt that the classification of land in the manner described above is responsible for the remarkable sales, and for the wonderful development which has taken place throughout the western section. Of the total area—irrigable and non-irrigable—only 5 per cent remained unsold in September, 1911. The water was turned into this canal in 1906, and ran the entire distance of the main canal and secondary canal A without serious accident.

For the convenience of British settlers, the "ready-made" farm scheme was devised. The company developed a certain number of farms, broke the land, put in the crops, built houses and barns, erected fences, and, in many cases, planted a crop, so that the settler, on arrival, had only to buy his household goods, live stock, implements, etc., and, practically, begin life where he left off on his old farm in England or Scotland. This has proved to be very successful and the demand for these "ready-made" farms has exceeded the

supply many times over. The payments for this development work are included in the payments for the land. The total payment is divided up into ten annual instalments, which cover the price of the land and buildings, but do not include the charge for water, which is payable each six months.

5. THE WHEAT CROP OF SASKATCHEWAN[1]

Wheat has become to Saskatchewan a symbol of outstanding significance on a par with coals to Newcastle, diamonds to Kimberley or gold to the Klondike. The golden grain of her prairies has become famous the world over and her marvelous yields of "number one hard" have placed her in a position of pre-eminence among the wheat-producing provinces and states of North America. In 1915 her wheat crop exceeded in value the total output of gold from the Klondike during the whole of its history. The annual production now exceeds that of Manitoba and Alberta combined, and in 1917 was more than double that of any state in the adjoining republic. Its average for several years has been well over the hundred-million-bushel mark, while in 1915, one of its "bumper" years, it reached well beyond two hundred millions. This is composed entirely of the famous hard spring wheat which makes the finest of flour so eagerly sought by all classes. The entire area sown to wheat as yet has not exceeded one-tenth of the available area judged suitable for grain-growing so that the outlook for still greater yields is indeed encouraging.

The commencement of seeding operations during the past ten years has varied from April 1 to May 6 with a ten-year average for the whole province of April 8. The corresponding average for general seeding operations was April 18. Harvest operations usually commence about the middle of August. Wheat-cutting is completed on an average by the end of the first week of September, barley-cutting a few days earlier, oat-cutting about the middle of the month, and flax-cutting by the end of the month or early in October. Threshing commences about the middle of September or slightly earlier and is rushed to completion as rapidly as labor and weather permit.

[1] Adapted from F. H. Kitto, *The Province of Saskatchewan*, Natural Resources Intelligence Branch, Department of the Interior, 1919, pp. 69–85.

Wages for threshing help for 1917 averaged for the province at $4.25 per day, the farmer providing the board as usual. The nominal wages in the southern half of the province were from $4.00 to $4.50 and $5.00 per day, while in the northern part, wages were slightly lower, ranging from $3.00 and $3.50 to $4.50.

The large straw-burning steam threshing engines so common a few years ago are now being replaced by gas engines of the traction type which are also employed in plowing and cultivating the land. The storing of the grain is provided for by some 2,000 elevators with a total capacity of about 60,000,000 bushels in addition to the Moosejaw and Saskatoon interior elevators of 3,500,000 bushels capacity each.

After threshing operations are completed as much land is plowed as time will permit before freeze-up occurs. The fall of 1914 was an open one and the farmers were enabled to complete two-thirds of their plowing. Usually less than half this work can be accomplished before winter sets in, the balance being left over till spring.

The various cities, towns, and villages of the province have sprung into existence to meet the requirements of their immediate vicinities as the land became settled, and their growth has been entirely dependent on, and in harmony with, the progress of agricultural development.

The agricultural barometer indicates the state of the city's business as accurately as it does that of the farm. As the time for harvest approaches the banker watches the weather as anxiously as the farmer. Railway companies and financial institutions send out an army of experts to keep them supplied with crop reports and estimates of the probable yield. Almost every business move depends on these reports. Let an adverse rumor appear and a spirit of retrenchment or economy permeates the air. But let a bumper crop be announced and everybody smiles. Railroads rush in empty cars on every siding in readiness to receive the golden grain, bankers work overtime changing money, and business everywhere booms. Implement dealers relax their anxious vigils while the piano agent gets his opportunity to make a record sale. The success or failure of the crop is of vital interest to every home and forms the chief topic of conversation on the street, in the club, or about the family fireside as the climax approaches.

6. ROUTES BY WHICH CANADIAN GRAIN IS SHIPPED FROM LAKE SUPERIOR PORTS TO THE ATLANTIC SEA-BOARD[1]

Canadian grain is shipped from Fort William, Port Arthur, and Duluth, the principal grain-shipping ports on Lake Superior, to the Atlantic sea-board via one of the following routes:

I. All-water route to Montreal.[2]

II. Water to Lake Huron or Georgian Bay ports, thence by rail to Montreal.

III. Water to Lake Erie ports, thence by rail to United States Atlantic ports.

IV. All rail to Montreal.

I. *All-Water Route to Montreal.* Unquestionably the cheapest means of carrying wheat from Fort William to Montreal should be by continuous passage in the hold of one steamer. The efforts of those responsible for developing and controlling the inland waterways of Canada and their trade should be directed primarily therefore to the fostering of this trade. This can be done in two ways at least:

a) By deepening and improving the Welland Canal and St. Lawrence River between Montreal and Lake Ontario so that any lake steamer may be able to go to Montreal, and ocean freight steamers may be able to come to Fort William;

b) By stimulating trade between the Maritime Provinces and Western Canada, and between Great Britain and Western Canada, in order that there may be more low-class freight for water transportation west from Montreal, and the disparity between the volume of eastbound and westbound commodities of Canadian origin may be lessened.

At the present time, were it possible for the large vessels that ply between the upper and lower lakes to go through to Montreal, they would have to come back empty to Oswego or Cleveland for cargoes of United States coal. They would therefore have to charge twice as high a rate, in proportion, for the trip from the lower lakes to Montreal as for the trip from the upper to the lower lakes. The greater risk said to attend the navigating of very large vessels in comparatively

[1] Adapted from *Report of the Grain Markets Commission of the Province of Saskatchewan* (Regina, 1914), pp. 35–47.

[2] Halifax or Portland in winter.

narrow channels in ballast as compared with under load would also have to be taken into account.

It may be assumed, then, that a large increase in the volume of commodities, originating at or east of Montreal, offering for carriage all water westward, must develop or be developed coincident with the improvement of the Upper St. Lawrence and Welland Canal waterways (which latter work is already under way), if these improvements are to result in materially decreased charges for the carriage of grain from Fort William to Montreal.

At present about one-third of the grain shipped by vessel from Canadian upper lake ports for export through Canadian channels goes through in the same vessel to Montreal. All the vessels in this trade have a carrying capacity of less than 100,000 bushels. They must be able to navigate the fourteen-foot channels of the present Welland and Lachine canals.

This direct route is, as stated, the cheapest, but it cannot take care of all the business offering. Also, grain that is shipped by this route cannot be placed in the elevators that offer the cheapest winter storage in Canada, viz.: those on Lake Huron and Georgian Bay. Another all-water route, that does not receive so large a volume of traffic (or at least did not, prior to 1913) but is nevertheless a factor in determining prices, is that which includes transhipment from large vessels to a smaller at Port Colborne, or from lake vessels to barges at Kingston. Port Colborne which, it will be remembered, is at the upper or Lake Erie end of the Welland Canal, carries the same rate from upper lake ports as Georgian Bay ports or Buffalo. It also carries the same rail rate to Montreal, viz. 5 cents (but complains of a car supply much inferior to that accorded to Lake Huron and Georgian Bay ports).

Port Colborne's position on the all-water route makes it a very suitable point for the transfer of cargoes of grain from the large vessels plying between the upper and lower lakes, which vessels then cross over to Cleveland and secure cargoes of coal for Duluth or Fort William. The grain cargoes may then be forwarded to Montreal, either by rail or by smaller vessels drawing not more than fourteen feet of water. In all respects Port Colborne is a well-laid out, well-built, well-equipped port, which, though small, is being steadily added to, and is thoroughly modern.

The other all-water route involving transshipment in transit has Kingston, near the eastern end of Lake Ontario and at the head waters of the St. Lawrence, as its transfer point. As the Welland Canal with at present only a fourteen-foot waterway lies between Kingston and the upper lake ports, only boats having a capacity of less than 100,000 bushels of wheat can make this port at the present time. Kingston is a point from which a number of flour mills in Ontario draw their grain supplies. A number of vessels, too, discharge grain cargoes at this port and cross the lake to Oswego for return cargoes of coal.

Kingston anticipates great development as a grain-handling port to result from the deepening and improving of the Welland Canal. This work, already under way, will when completed admit to the waters and ports of Lake Ontario any vessel now on the upper lakes. Even if these big vessels have to steam to Cleveland in ballast of their return cargoes of coal, Kingston anticipates that it will secure a freight rate on grain from upper lake ports not more than one-half cent in excess of the rate to Port Colborne and Buffalo. In readiness for this looked-for business, the Dominion government is constructing an entirely new port in the mouth of the Rideau River at Kingston. At the new quays any lake vessel will be able to berth in safety.

Volume of Shipments by Various Routes. So far we have dealt with what should be the principal route for the transportation of our wheat from Lake Superior ports to ocean ports, viz.: the all-water route. Whatever this route may become in the future, it has at the present time two strong competitors. One is the lake and rail route to Montreal, Boston, and Portland via Georgian Bay and Lake Huron ports, and the other is the route via Buffalo to United States Atlantic ports, principally, New York, Philadelphia, and Baltimore. During the seasons of navigation, 1910–11–12, shipments of wheat were routed from Fort William and Port Arthur as indicated in Table XVIII. Four facts are revealed by this table:

a) An increasing percentage of the shipments from Fort William and Port Arthur, reaching 42 per cent in 1912, go to Buffalo or other United States ports for export in bond from United States Atlantic ports;

b) Of the shipments to Canadian ports, about half go to Georgian Bay and Lake Huron ports, and about half to Lake Erie or Lake Ontario ports, or to Montreal direct;

c) Port Colborne has relieved Kingston of a lot of business;

d) The tendency is to concentrate the trade along a number of clearly defined routes rather than scatter it among many small ports.

It must be borne in mind that not all of this grain is for export; many millions of bushels are milled in Ontario and Quebec. On the other hand, these figures do not include all the grain that is exported. They take no account of all rail shipments, or of shipments of bonded grain from Duluth.

TABLE XVIII

	1910 Bushels	1911 Bushels	1912 Bushels
Georgian Bay and Lake Huron ports...	27,867,774	28,275,705	40,069,982
Port Colborne	3,020,256	6,441,912	12,255,471
Kingston	12,156,343	11,051,582	10,973,995
Montreal	11,137,225	11,794,572	14,938,508
Other Canadian ports	1,025,653	923,906	549,698
Buffalo	21,916,003	33,245,045	44,627,965
Other United States Lake ports	1,257,801	3,449,289	12,130,327
Total shipments by vessel	78,381,035	95,182,011	135,545,946

II. *The Georgian Bay and Lake Huron Route.* Rates by this route are less variable than by the all-water route to Montreal in one bottom. The railway rate from Georgian Bay and Lake Huron ports to Montreal is stationary at five cents per bushel of wheat, including elevating charges at both ends and an aggregate of fifty days' free storage. The lake rate from Fort William and Port Arthur to Georgian Bay and Lake Huron ports of recent years has fluctuated between one and one-half cents and two and one-half cents. As soon as this rate reaches two cents, additional vessels are attracted to the grain-carrying trade from ore carrying, and this operates to keep these rates from going much above two cents. Thus the total charges on wheat from Fort William to Montreal by this route in recent years average about seven cents per bushel of wheat. The through rate, all-water, in one vessel to Montreal averaged practically five cents in 1911, and six cents in 1912. The through rate, however, includes no elevation or delivery charges at Montreal or any free storage, while the lake and rail rate includes elevation and delivery charges and a maximum of fifty days' free storage. To the exporter desiring storage these requisites of the lake and rail route are worth

one and one-third cents per bushel, as elevation from vessel to elevator and delivery to ocean steamer, including twenty days' storage, would cost him three-fifths of a cent per bushel, and the additional thirty days' storage would cost him three-quarters of a cent per bushel at Montreal.

Another advantage which the lake and rail route enjoys is access to the cheapest winter storage in Canada. Western wheat marketed at any time during the autumn is exported approximately a month later, but subsequent business is largely for May or June delivery. Thus the exporter must be prepared to acquire a quantity of grain in the late fall and store it until the following spring.

III. *The Route Via Buffalo and United States Atlantic Ports in Bond.* It is to be regretted that with such a magnificent waterway as the St. Lawrence in our possession, Canadian grain should be exported through any but Canadian channels. There is, however, some slight compensation in the fact that a considerable quantity of United States grain is exported via some Canadian ports, principally Montreal. The following statements set forth the volume of these two crossing streams:

Quantity of Canadian wheat exported from United States ports in the years mentioned:

	Bushels
1909	23,487,488
1910	27,129,471
1911	24,192,228
1912	55,507,853

Quantity of United States wheat exported from Canadian ports in the years mentioned:

	Bushels
1908	10,908,194
1909	12,761,605
1910	3,884,202
1911	1,623,172
1912	7,335,494

Practically all of these exports were from Montreal.

It has been pointed out than an increasing percentage of our grain shipments from Fort William and Port Arthur, amounting in 1912 to

42 per cent, go to Buffalo or other United States lake ports for export in bond through United States Atlantic ports.

It will be noted that in spite of the much greater distance from upper lake ports, and the fact that Buffalo lies east of Cleveland (the source of the return cargo) lake freight rates to Buffalo are as a rule less than to Canadian ports on Georgian Bay and Lake Huron. The Commission believes that the principal cause for this apparent discrimination lies in the fact that shipments from Canadian upper lake ports to United States lower lake ports are international business and as such are open to either Canadian or United States vessels, while shipments from Canadian upper lake to Canadian lower lake ports are Canadian business and as such are, under Canadian government coastal regulations, available only to vessels of British register. Whatever the causes may be, this alternative remains: either the lower rate for the longer haul to Buffalo is unremunerative (in which case United States vessels would scarcely accept this business, whereas at present they do the most of it), or the higher rate for the shorter haul is unduly remunerative to Canadian vessel owners who are only enabled to levy the extra charges by reason of being protected from outside competition by coastal regulations.

The explanation of the increasing shipments to Buffalo, in spite of the heavier charges levied on shipments routed via United States channels, is to be found in four facts:

a) The ports of New York, Baltimore, etc., are open twelve months of the year, whereas the port of Montreal is open only seven months of the year; it is to these United States ports that grain shipped to Buffalo goes for export;

b) Ocean insurance rates and, partly in consequence, ocean freight rates are much lower from United States Atlantic ports than from Montreal;

c) In consequence of high insurance rates and the port being smaller, there is less certainty about securing ocean space at Montreal just when needed than at United States Atlantic ports;

d) Both United States and Canadian vessels are available for shipments to Buffalo or other United States ports, while only Canadian vessels are available for shipments to Canadian ports, and owing to the seasonal nature of the business there is not always sufficient Canadian tonnage to take care of it.

Before passing from the consideration of lake routes and relative proportions of exports via Montreal and via United States Atlantic ports, it is worth noting the possibility—indeed, the probability in the eyes of many—that these routes and the charges levied on them may be revolutionized about 1916 by the influence of the new Erie Canal which it is expected will be opened for traffic in that year. The locks at the Soo are being enlarged, and our own Welland Canal is being made a thoroughly modern ship canal at considerable expense. These enterprises are completely eclipsed in extent, and their effect may be more than offset, by the waterway to connect the waters of Lake Erie at Buffalo with those of the Hudson River at Albany. On this waterway the state of New York is spending, so the commission is informed, $120,000,000.

IV. *All-Rail Shipments.* The following statement (Table XIX) shows the relative proportions of the volume of shipments from Canadian upper lake ports by vessel and by rail respectively. It will be noted that the movement all rail is considerable:

TABLE XIX

Crop of Year	Vessels	Rail	Totals
1908	65,237,160	10,568,154	75,805,314
1909	88,845,141	9,992,726	98,837,867
1910	86,108,260	7,271,976	93,380,236
1911	115,702,078	23,620,883	139,322,961
TOTAL	355,892,639	51,453,739	407,346,378

Percentage by vessel for the four years, 87.3 per cent.
Percentage by rail for the four years, 12.7 per cent.

CHAPTER VII

PACIFIC CANADA—THE CANADIAN CORDILLERA

1. FOREST REGIONS OF BRITISH COLUMBIA[1]

The climatic conditions of British Columbia include a heavy rainfall and an extended growing season along the coast, and, in the interior, long winters, with consequent conservation of the snowfall, and moderate rainfall in the summer, in conjunction with a short but vigorous growing season. These conditions insure, throughout almost the whole of the province, a dense forest growth with rank undergrowth. Only at low altitudes, in the dry belt—which is the term applied to the section lying between the Cascade Range and the foothills of the Gold and Cariboo mountain ranges—and in the lower portions of the Kettle, Columbia, and Kootenay valleys, do long, hot summers and light rainfall restrict the forest growth to arid types or prevent it altogether.

Using climatic factors as the basis of forest classification, seven broad regions may be distinguished. The approximate area included in each of these regions is indicated in the following table. The total of 120,000,000 acres is for that portion of the province under administration and excludes about 40,000,000 acres of barren areas within the different regions.

	Acres
Douglas Fir Coast region	18,000,000
Northern Coast region	20,000,000
Interior Wet Belt region (Gold and Cariboo Ranges)	22,000,000
Yellow Pine region (semi-arid interior valleys)	5,000,000
Plateau and Rocky Mountain region	26,000,000
Upper Fraser Basin region	14,000,000
Northern Interior region	15,000,000
TOTAL	120,000,000

[1] Adapted from R. E. Benedict, "Disposal of Logging Slash in British Columbia," in *Forest Protection in Canada, 1913–14, Commission of Conservation of Canada*, 1915, pp. 101–12. When this article was written Mr. Benedict was Assistant Forester, British Columbia Forest Branch.

Eliminating the land capable of agricultural development, which is estimated at 15,000,000 acres, there are left 105,000,000 acres of land whose only value to the province (outside of the grazing value of 20,000,000 acres) is its adaptability to the production of timber. The province is truly a forest country, and, with agricultural land occupying less than 10 per cent of its area, it is evident that its future is inseparably bound up with the crop of timber which can be grown on this 105,000,000 acres. The climatic and soil conditions are, for the most part, excellent, and it is believed that the annual cut, which already amounts to nearly 2,000,000,000 board feet and makes the lumber industry the leading one of the province, can be increased by four times without overtaxing the productivity of the forest growth. But, to accomplish this, measures must be adopted to insure prompt regeneration of the forest, to afford the most favorable conditions for rapid growth, and to protect the growing crop from destruction by fire. The chief obstacle to the attainment of all these conditions is the presence, in the most valuable and productive forest areas, of a heavy layer of undecomposed vegetable material, made up of leaves, twigs, branches, fallen trees, grass, and weeds, which accumulate in the 100 years or more during which the forest is growing to maturity, as well as the immense amount of slash, consisting of the crowns of cut trees, and of unusable trees, young growth, and brush, which is produced in removing the merchantable material. Undoubtedly, as the value of timber increases and as new uses are found for wood, the amount of slash will be lessened to some extent, but no material improvement in conditions will take place for many years. The leading two regions in the production of lumber are the Douglas Fir Coast Region and the Interior Wet Belt Region.

Douglas Fir Coast Region. An annual precipitation of over 50 inches, a mean temperature of 45 degrees, with an absence of extremes, a humid atmosphere, and a long growing season, which characterize the climate of the southern coast and the greater portion of Vancouver Island, produce a coniferous forest which is only equaled for density, rapidity of growth, yield, and individual tree development in the coast regions of Oregon and Washington, where the same climatic conditions prevail.

The forest is everywhere very dense, regardless of age, with a very rank undergrowth of shrubs and hemlock seedlings, and a heavy

deposit of dead leaves, branches, and down trees, all covered with a thick layer of moss. The mature stands bear from 10,000 to 100,000 feet, board measure, per acre, with an average of 20,000 feet. Commercially, Douglas fir is the most important forest type in British Columbia, furnishing at the present time over 1,000,000,000 board feet annually, or two-thirds of the lumber cut of the province.

Interior Wet Belt Region. Paralleling the Coast Range, at a distance of about a hundred miles, and separated from it by a broken or rolling plateau averaging 3,000 to 4,000 feet in altitude, though intersected by several deep valleys, the Gold and Cariboo mountain ranges rise to a height of 5,000 to 8,000 feet, and maintain this altitude for a length of 350 miles north of the International Boundary. The Gold Range is paralleled again for a length of 250 miles—at a distance of 80 miles further east—by the Selkirk Range, the deep valley of the Columbia lying between the two ranges. This region of parallel mountain ranges and their many peaks, all separated by deep valleys, is characterized by a climate which partakes somewhat of the nature of those of both the coast and dry belts.

The annual precipitation amounts to between 30 and 40 inches, the average annual temperature is in the neighborhood of 40 degrees, with warm summers, and winters which, though cold, are free from long periods of extreme low temperatures. The growing season is long, considering the latitude and altitude, with a comparatively humid atmosphere. The heavy snowfall insures plenty of moisture in the beginning of the growing season and, generally, there is sufficient rainfall in July and August to maintain most favorable growing conditions throughout the summer. Locally, this region is known as the second, or interior, wet belt, and the term has been applied to the very distinctive forest which the favorable climatic and soil conditions produce.

While many sub-forest types are found in the region, the forest generally is characterized by great density, rapid growth, a large yield, and excellent individual tree development, although, of course, it does not equal that found in the Douglas fir coast region.

Cedar, hemlock, Douglas fir, lodgepole pine, and spruce are found over nearly the whole region, while western white pine is a constitutent of the stand on the Columbia and North Thompson watersheds.

Probably no equally extensive forest region on the continent has suffered so severely from fire as has this district, it being estimated that 75 per cent of the forest has been burned over at least once during the last 50 years, destroying 100,000,000,000 feet of timber. The burns, however, all promptly restocked, showing that fire, by removal of the dead vegetable covering, creates the conditions necessary to regeneration.

Commercially, this region is second in importance only to the coast fir region, yielding about 300,000,000 feet in 1913. In the possibilities of future production, it probably excells the coast fir region, owing to its greater area of productive land, most of which is covered with an excellent young growth.

2. WATER-POWER POSSIBILITIES OF BRITISH COLUMBIA[1]

The conditions affecting water-power development in the provinces of British Columbia are unique and do not closely correspond to those existent in other portions of Canada. This is true especially of the mainland Pacific Coast, Glaciers, snow-fields, heavy rainfall, and dense forests abound. All of these help to maintain a steady flow of water in the streams throughout the year. Moreover the gradients of the streams are steep, and the storage possibilities adequate so that as far as physical conditions are concerned British Columbia is one of the most promising regions of North America in regard to water-power.

Grand totals purporting to represent horse-power possibilities for large sections of a country are apt to be very misleading. They are especially misleading when used to make comparisons with other totals when, as a matter of fact, no real basis for comparison has been established. The unique character of many of the water-power possibilities of British Columbia, with its exceptional physical features, such as mountain systems, glaciers, snow-fields, and widely variant precipitation, necessarily makes it difficult to effect comparisons between the total water-power possibilities of this province and those of other areas differing markedly in physical characteristics. However, it will be interesting to present in round numbers certain totals of horse-power derivable from the various estimates presented in our tables.

[1] Taken from Arthur V. White, *Water Powers of British Columbia*, Commission of Conservation of Canada, 1919, pp. 4–5. Mr. White is Consulting Engineer, Commission of Conservation.

Conventionally the province has been divided into districts as follows:

	24-hour horse-power
I. Columbia River and tributaries: (North of the international boundary): This comprises the portion of the province lying between its eastern boundary and the watershed of the Fraser River	610,000
II. Fraser River and tributaries: This includes practically the entire area of the great Interior Plateau	740,000
III. Vancouver Island	270,000
IV. Mainland Pacific coast and adjacent islands: (Except Vancouver Island): This includes all the rivers north of the Fraser which drain into the Pacific	630,000
V. Mackenzie River tributaries: (A rough estimate made for inclusion in this summary)	250,000
Grand Total	2,500,000

The foregoing totals include about 250,000 horse-power for plants already in operation, but they do not include about 400,000 horse-power given in the tables for power possibilities on streams like Fraser, Thompson, Skeena, and Nass rivers, on which, because of the proximity of railways, or possible interference with the salmon industry, economical development cannot be considered under present conditions. Also, as elsewhere explained, there is still considerable territory, especially in the more northerly portion of the province, which it has not been possible to investigate fully. These areas may yet disclose a considerable amount of power. One fact to be borne in mind in connection with these totals is that, when powers are developed and the available waters are intelligently conserved, more power will be obtained than the quantities estimated upon the basis of available data would, at present, indicate. In round figures, the total estimated 24-hour power, including an allowance for all of the entities above mentioned, may be placed at about 3,000,000 horse-power. It must be understood that the utilization of this water-power will involve closely related problems of domestic and municipal water supply, irrigation, navigation, fisheries, and riparian rights. Too frequently, in planning for water-power development, such problems are ignored.

3. PUGET SOUND-FRASER RIVER SALMON INDUSTRY[1]

The sockeye salmon which frequent the Fraser River in British Columbia are natives of that stream. All of them are hatched in its watershed and, with few exceptions, spend the first year of their life in the fresh waters of some one of its many large lakes. They then migrate to the sea, where they remain until the summer of the year they are four years old, when they again seek the waters of the Fraser to spawn, and, after spawning, die.

In returning from the sea to the Fraser, the salmon pass through many miles of American waters in the state of Washington, and there the greater proportion of the run is caught by American fishermen. It is the feature of the fishery that makes it an international one. In dealing with the salmon fisheries of the Fraser, it is necessary to deal also with the fishing operations carried on in American waters through which they pass, since it has been demonstrated that all the sockeye salmon which are taken in Puget Sound, in the state of Washington, are Fraser River bred fish. The term "Fraser River district" is here used to include all the American and Canadian waters in which the Fraser River fish are caught. In order to show an increase or decrease in the run of sockeye to the Frazer for a given year, it is necessary to compare the catch of that year with the catch in the fourth preceding year, since, as already set forth, the sockeye that run to that river predominately mature in four years, and since the sockeye seeking the Fraser are caught in both Canadian and American waters, it is necessary to take the combined catch in those waters in order to ascertain the total for any year.

Up to the present year (1917) the run of sockeye salmon to the Fraser River district made it the most valuable and, at the same time, the most remarkable salmon fishery known. Every fourth year, up to 1917, the run of sockeye salmon in that dristict has greatly exceeded the run to any other river, and has so greatly exceeded the run to the Fraser in the three following years that it is termed "the run of the big year." The run to the Fraser in each of the three years

[1] Adapted by permission from John Pease Babcock, "Salmon Fishery of the Fraser River District," *Ninth Annual Report of the Commission of Conservation, Canada*, 1918, pp. 140–47. When this article was written Mr. Babcock was Assistant Commissioner of Fisheries of British Columbia.

succeeding the big year is so much smaller, that those years are termed "the lean years."

Nineteen hundred and nine was a year of a "big run." The pack in the district that year totaled 1,683,339 cases, each case containing 48 one-pound cans or their equivalent. The *combined* pack of the three following lean years totaled but 893,253 cases, or 53 per cent of that of 1909.

The pack in 1913, the next big year (and, as will later be shown to have been the *last* big year) totaled 2,392,895 cases, while the *combined* pack in the three following lean years totaled but 805,910 cases, or 35 per cent of that of 1913.

A study of the recorded pack of sockeye salmon caught in the Fraser River district for the past eight years, 1909 to 1916, inclusive, affords a comprehensive basis for an understanding of conditions in both provincial and state waters of that district up to 1917. It demonstrates the vast difference between the catch in the big and in the lean years up to that year, as well as the great difference in the proportion of the catch in the provincial and the state waters, and it also shows the decline in the run in the lean years.

TABLE XX

PACK OF SOCKEYE SALMON CAUGHT IN FRASER RIVER DISTRICT, 1909–1917

Year	British Columbia waters	State of Washington waters*	Total for District
1909	585,435	1,097,904	1,683,339
1910	150,432	248,014	398,446
1911	58,487	127,761	186,248
1912	123,879	184,680	308,559
1913	719,796	1,673,099	2,392,895
1914	198,183	335,230	533,413
1915	91,130	64,584	155,714
1916	32,146	84,637	116,783
TOTALS, 1909–1916	1,959,488	3,815,909	5,775,397
1917	148,164	300,000†	448,164

* Data from *Pacific Fisherman*, Seattle, Wash. † Estimate.

The pack for the eight years, 1909 to 1916, inclusive, includes the catch of the last two big years and the last six lean years. Together,

they constitute the last two four-year cycles of the run to the Fraser River. The grand total for the eight years is 5,775,397 cases, of which 33.9 per cent was packed in British Columbia, and 66.1 per cent, in the state of Washington. In every recent year, except 1915, the catch in the state of Washington waters of the district has exceeded the catch in British Columbia waters.

The history of the fishing in the Fraser River district in the past fourteen years is a record of depletion, a record of excessive fishing in the lean years, a record of failure on the part of the authorities of the state of Washington to realize the necessity of conserving a great fishery, notwithstanding convincing evidence submitted to them by agents of their own creation that disaster was impending to one of their great industries.

The Canadian authorities, on the other hand, have, by their representations and acts, evinced, in unmistakable manner, their willingness to deal squarely and adequately with conditions that foretold depletion, and to join with the state of Washington or the United States Government in legislation to prevent it.

The failure of the state of Washington to recognize the necessity for and the advantages that would follow the suspension of sockeye fishing in the lean years in her own and the provincial waters of the Fraser River district is a reflection upon her business foresight. Her proportion of the catch of sockeye in each of the last three big years (1905, 1909 and 1913) has averaged 1,399,808 cases per year, of an average value of $11,198,464. Her average in each of the last six lean years has been 182,091 cases per year, of an average value of $1,456,728. The average value of her catch of sockeye in the big years up to 1917, exceeds the average value in the lean years by approximately $9,741,736 per year. Since, as has already been stated, the catches in both the big and the lean years are the product of the same spawning beds, it is evident that those spawning beds would have produced on the average as great a run in the lean years as they produced in the big years provided they had been as abundantly seeded. It is simply a question of seeding. The failure of the United States and the state of Washington to join Canada in measures to insure seeding those beds every year as abundantly as in the big years has, in the three lean years of the last four-year cycle, entailed a loss to the state of Washington alone of $29,225,208.

Turning from a consideration of the runs in the lean years to that of the run in the big years, we find that the report of the Fisheries Department of British Columbia for 1913 affords the basis of an intelligent conception of the conditions on the spawning grounds of the Frazer River, which, in that year, caused the decline in the catch in 1917. The reports from the spawning grounds contained in the report for 1913 demonstrate that the numbers of sockeye salmon which passed up the Fraser River that year were as great as in any previous big year of which there is record and possibly even greater. The capital stock of that year's run was not overdrawn even by the great catch of that season. In June, the adult sockeye made their appearance in the cañon of the Fraser, above the town of Yale and, during the high water of June and July, large numbers passed through the Quesnel and Chilko lakes at the head of the watershed. The greater proportion of the run of sockeye that reached the cañon at Yale in late July and during August and September were blockaded there by rock obstructions placed in the channel incident to railway construction, with the result that few of them were able to pass through the cañon during that time. The slide came from a cliff on the south side of the Fraser River, and was caused by the Canadian Northern Railway building a tunnel. The tunnel took away the support from the face of the cliff and it came down in one mass causing a waterfall of about 9 feet in the river, where only a rapid had existed before. This happened at one of the narrowest parts of the river, and the water shot over the fall with a velocity and in such a direction that the salmon could not jump it. Ordinarily, the height would not have stopped a salmon, but the velocity of the water was so great that they could not stem it. It was most interesting to watch the maneuvers of the salmon in trying to overcome that obstruction. They would coast along the shore of the river and take advantage of every little projecting point of rock or any little eddy that occurred, until they got right up to the point where no further protection was possible, and then they would make a jump for it, but they would be caught by the current and inevitably carried down. The blasting of temporary passageways enabled a large proportion of the October and November sockeye run to pass through the cañon and spawn in Shuswap and Seton lakes. In August, sockeye were seen drifting down stream, between the cañon and Yale; which movement was

very pronounced in September, and continued until the middle of October. The streams which enter the Fraser between the canon and Agassiz were filled with sockeye from the middle of August until the end of October, while they had not been observed in those streams in previous years. Very few sockeye spawned in any of these streams; most of them died without spawning. Vast numbers of dead sockeye, which died without spawning, were found on the bars and banks of the Fraser between Yale and Agassiz in September and October.

It was little less than a calamity that the rock slide, which so nearly destroyed the run of 1913, should have occurred in a year of the big run. The destruction of the spawning run in the Fraser in 1913 is the greatest disaster that has been recorded in the history of the fishing industry of the world. So far as the writer is informed, it has had no parallel. Estimated on the valuation of the pack of that year, the loss to the fisheries of the province of British Columbia in 1917 alone, is in excess of $8,000,000 and the loss to the state of Washington is in excess of $19,500,000, a total loss to the packers of that district of $27,500,000.

Furthermore, the loss will not be confined to 1917. It will be repeated every fourth year, until such time as the governments of Canada and the United States by united efforts, drastic and long continued, shall succeed in repopulating the spawning beds of the Fraser River with the millions of adult sockeye that spawned there every fourth year up to 1913.

4. WESTERN CANADA AND THE PACIFIC[1]

Two rival Canadian ports on the Pacific coast are of special interest at this time in view of the prospective opening of a Hudson Bay route to Europe for Western Canada's wheat fields and the strong leveling tendencies in cereal distribution that have their origin in the war. Vancouver is an established port, having all the strength that grows out of a fixed place in the commercial scheme. Its competitor, Prince Rupert, 400 miles north, is new and untried. It hopes to become a Pacific emporium and to rival not only Vancouver but

[1] Taken from Walter S. Tower, "Western Canada and the Pacific," *The Geographical Review*, October, 1917, pp. 284–96. Mr. Tower is special trade commissioner in the Bureau of Foreign and Domestic Commerce, Department of Commerce; formerly he was professor of geography at the University of Chicago.

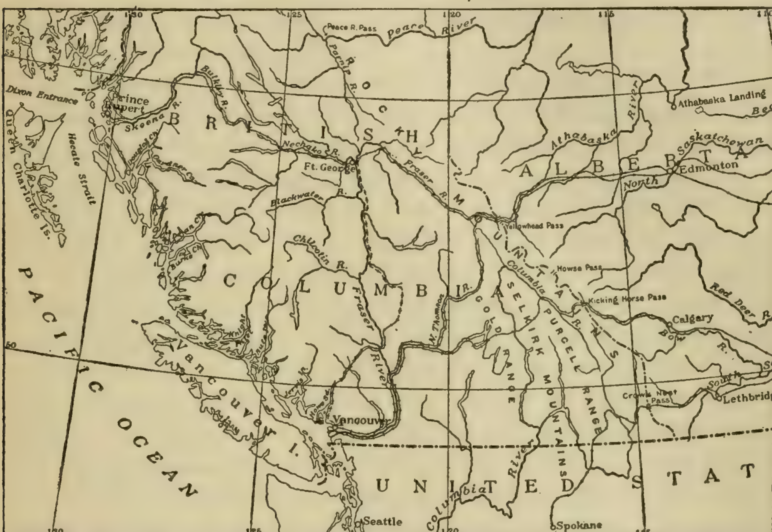
the cities of Eastern Canada. It is already the terminus of the Grand Trunk Pacific Railway. What are its tributary economic areas? In the commercial race that goes hand in hand with the swift agricultural development of the Canadian prairies, what are its prospects of success? To answer these questions one must look not only at the resources of the regions that feed these two outlets but also at the principles of port development that apply the world over.

The advance of farming across the Canadian prairies has been marked by the steady northward extension of the zone of active development, largely because of better climatic conditions in the north for the production of the chief commercial crops—wheat, oats, and flaxseed. Central Saskatchewan and the region westward to Edmonton, Alberta, quickly led in the heavy production of cereals. These newer farming localities lie to the north of the line of direct communication with the original Pacific outlet at Vancouver and occupy such positions with reference to other parts of the Pacific coast as to lead naturally to the consideration of building new railroads to new ports on the western ocean.

There are at least four large factors which obviously would influence the selection of routes to the Pacific from the Canadian prairies. In the first place, the distance to which the cultivated area is extended northward largely determines the practicability (or economy) of shipping by the original route (Canadian Pacific) to Vancouver. From the region of Edmonton, via Calgary, to Vancouver it is 100 miles farther and much more difficult than to more northerly Pacific points, as Prince Rupert. In the second place, the location of passes across the Canadian Rocky Mountains and of natural routes through the rugged belt to the west largely determines the feasibility of building new trans-Cordilleran railroads to connect the farming communities and the Pacific coast. There are a number of good passes across the main mountain ranges between the forty-ninth and the sixtieth parallels, which represent the approximate limits of the possible wheat-producing area. Some of these passes, however, are of little or no use to the region, because of unfavorable location with respect to producing centers or to trans-Cordilleran routes. Satisfactory routes through the belt of rugged highland four hundred miles wide must be sought along valleys, preferably those which extend all the way from the Rocky Mountains to the Pacific coast, or,

if necessary, along low-gradient valleys which head near each other on a low intervening divide (Map 2).

A third factor, equal in importance to either of the others, is the character and location of harbors, or sites for commercial ports, to be reached by these routes. British Columbia has a typically fiorded coast, which means there are many deep, well-sheltered



Map 2.—Sketch-map showing rivers and routes of western Canada. Scale, 1:15,000,000. *Note:* For "Parnip R." (56° N.) read Parsnip R.

indentations (Map 2), more in fact than possibly could be utilized as harbors in the development of commercial centers for Pacific Canada. For various reasons, however, many of these identations are unsuitable for port developments, as is illustrated by the typical case of Bute Inlet. In some the water is too deep to provide good anchorages; some have such narrow, winding entrances as to make the passage of vessels difficult or unsafe; a majority are bordered by land too precipitous, or too rugged, to permit satisfactory development of an important commercial city; and nearly all of them are difficult to reach from the interior. To these general objections, applying in one way or another to almost all the indentations, there must be

added the fact that nearly half the mainland coast of British Columbia lies back of Vancouver Island (Map 2), which means that, except for the indentations near the northern and the southern ends of the island, a serious handicap is imposed by the long and roundabout route necessary to reach these harbors, which lie shut off from the open ocean by the island barrier. Finally, the natural resources and economic prospects of the country to be traversed would vitally affect profitable railroad development, and so influence the choice of routes.

Of the four enumerated factors apparently the greatest is the character and location of the valleys. Outside the routes made possible by the chief valleys, the high altitudes and extreme ruggedness would involve steep grades, high costs of construction and of operation, and other handicaps serious enough, presumably, to prevent any attempts to build trans-Cordilleran lines. Excluding valleys in British Columbia that lead into the United States or the territory of Alaska, the zone of possible port development is narrowed to the strip between latitude 49° and latitude 54° 40′, or a straight-line distance of only 400 miles. Within these limits there are numerous streams entering the Pacific, each one of which has fiorded sections close to its mouth and potential harborage; but most of these streams rise in, or on the Pacific side of, the Coast Range and do not provide outlets for trans-Cordilleran routes (Map 2). Only two of the rivers, the Fraser and the Skeena, receive tributaries which rise very far to the east of the Coast Range, and thus their valleys are the only ones which provide large gaps in the great topographic barrier of coastal British Columbia.

The Fraser has a system of three important tributary lines, one from the east, one from the northeast, and one from the north (Map 2), or, as they may be named according to tributary waters, the South Thompson-Fraser, the North Thompson-Fraser, and the main Fraser routes, uniting in the lower valley which comes out to the Pacific nearly opposite the southern end of Vancouver Island. These three tributary valleys, furthermore, head toward the eastern edge of the Cordilleran belt and not far from good passes over the Rocky Mountain barrier. The Skeena, on the other hand, has a much smaller system, enters the ocean close to the Alaskan boundary, and has only two tributary lines, one from the north and one from the

east, the main Skeena and the Bulkley. Neither of these valleys heads close to the Rocky Mountains, but both must be approached from the east through the valleys occupied by the upper waters of Fraser or Peace River tributaries (as the Nechako and Oslinka).

In the four hundred miles between the Fraser and the Skeena, several rivers enter the conspicuous "channels" or "inlets," as they are there called, but they are of no commercial value. Nothing would be gained, for example, by seeking outlets from the Fraser River basin, in central British Columbia, over the divide of the Coast Range, into such valleys as those which lead to Knight, Bute, Toba, and Jervis Inlets (Map 2). The two rivers entering Douglas Channel, and Gardner Channel north of Vancouver Island are only a hundred miles from the mouth of the Skeena. They are comparatively short streams, heading on the western slope of the Coast Range. The only other ones which are worth mentioning head east of the Coast Range: the Salmon River flowing to Dean Channel, and Bella Coola River to Burke Channel (Map 2). Between their headwaters and the tributaries (Blackwater and Chilcotin) of the Fraser system, however, there is the obstruction of a comparatively broad and high divide. Further, the route from prairie points via one of these valleys to the coast would be very devious, and the coastal topography is prohibitively rugged.

There is not much difference in the quality of the harbors of Vancouver and Prince Rupert;[1] each harbor is large enough and deep enough to accommodate all the shipping that it may be called upon to receive. They are admirably protected by lines of sheltering islands and prominent headlands. Both have long usable water frontage, offering almost unlimited possibilities for wharf and dock development. Both have adjacent sites suitable for the development of cities of large proportions. The moderately hilly character of the land about the harbors makes town sites unusually attractive both from the standpoint of scenery and that of public health. The only notable difference between the harbors is in the character of the entrances. Vancouver lies some distance north of the southern end

[1] Except for harbor conditions the factors affecting Vancouver may be said to cover the other towns of that district, including New Westminster, North Vancouver, and Port Mann; while Prince Rupert likewise covers the case for Port Edward, Port Essington, and Port Simpson.

of Vancouver Island, which necessitates a voyage of approximately 200 miles, through the Strait of Juan de Fuca and the Strait of Georgia (Map 2), where, in foggy or stormy weather, the problem of navigation may be difficult. Prince Rupert, on the other hand, through Dixon Entrance to the west or the broad Hecate Strait to the south (Map 2), has a wider, more direct, and somewhat shorter entrance from the Pacific. However, this advantage is probably altogether too small notably to affect the development of Prince Rupert.

What is the character of the land adjacent to the two localities? Within a radius of a hundred and fifty miles from either port the land is rugged, heavily forested, with small agricultural possibilities, and for the most part not known to be especially rich in mineral resources. There is more cultivable land near the lower Fraser valley and on Vancouver Island, however, than there is near the lower Skeena valley and on the Queen Charlotte Islands, for it might almost be said that good agricultural land of any considerable extent does not exist within a hundred and fifty miles of Prince Rupert. There is also a difference in the character of the forests. Along the southern part of the British Columbia coast is found one of the most valuable commercial forests of fir, hemlock, and cedar in North America. In the vicinity of Prince Rupert, on the other hand, where conditions (of climate especially) are less favorable, the trees are smaller, the stand is not so heavy, and there is a predominance of the less valuable kinds, like hemlock and spruce.

The Vancouver region appears in the present state of information to be superior in mineral resources. At all events, there is little reason to suppose that the productive coal fields of Vancouver Island are equaled by deposits in the lower Skeena basin.

Prince Rupert is nearer to Alaska; it is nearer to Oriental ports as far south as Shanghai; and it is the Pacific terminus of the shortest route (now and probably for the future) between eastern Canadian (or western European) localities and those Oriental centers north of Shanghai. Vancouver, on the other hand, is nearer to the United States, to the Panama Canal, to all points reached by way of the canal, and to places in the Orient south of Shanghai. The sailing and steamship routes most frequented in the Pacific lie mainly far to the south of Prince Rupert. Hence existing trade relations for the Pacific seem unlikely to lead to the passage of shipping close enough

to Prince Rupert to make that place a convenient port of call. Shipping between Alaskan and southern ports, relatively unimportant, is the only exception to this condition. Vancouver, on the contrary, is much more favorably located with reference to the long-established (and probable future) shipping routes in the North Pacific, largely as a result of its proximity to the important Pacific ports of the United States.

The relative merits of the routes inland from Vancouver and Prince Rupert must be determined largely on the basis of (1) distances between the ports and their respective productive areas, (2) the potential resources of the Cordilleran section through which the lines run, and (3) the extent and character of the entire region from which traffic can be drawn. It may be noted, first, that a radius of 500 miles (air-line distance is in this case comparable to road mileage) from Vancouver as a center, includes all the Cordilleran (British Columbia) region south of latitude 56°, and the western margin of the prairies from the Peace River country on the north to the plains of southern Alberta, over a width ranging from a hunderd to two hundred miles east of the Rocky Mountain axis. A similar radius from Prince Rupert as a center includes the greater part of central and southwestern British Columbia, but only a relatively small strip of the prairies, mainly in the Peace River country and to the north. The area lying exclusively within the Prince Rupert radius, in north-central British Columbia and the northern prairies is less valuable economically than the areas lying exclusively in the Vancouver radius in southern British Columbia and the southern prairies. So far as mileage of land haul is a factor, Vancouver seems to have a substantial advantage in being nearer to large regions with good prospects.

The economic possibilities of the country traversed by railway lines in the Fraser basin are largely superior to those touched by railroads through the Skeena basin. Agricultural opportunities are just as good, if not better; forest resources are conspicuously greater; and mineral deposits, so far as is known, are much richer in and near the southern valleys than in those to the north. Thus, within the area naturally to be tapped by way of the Fraser routes, lie nearly all the important mineral-producing regions in the mainland of British Columbia. As a source of local traffic and an aid to

profitable operation, therefore, the valleys of the Fraser system are the best for railroad routes between the prairies and the coast.

The extent of the region from which traffic logically may be drawn can hardly be marked out with rigid limits, but it must consist largely of British Columbia and the prairies east of the mountains about as far as central Saskatchewan. East of Saskatchewan and perhaps in the eastern half of that province, there probably will continue to be some advantage in moving the traffic by way of an existing eastern outlet, or by one of the lines under construction (as the Hudson Bay route), except in the case of a limited traffic for Pacific destinations.

Southern British Columbia is more rugged than the central and northern parts of that province, hence the section closest to Vancouver contains less land well suited to agricultural and pastoral pursuits than the middle and upper Fraser basin, about equidistant from the two ports. Agricultural and pastoral possibilities, however, are not likely to operate in a large way in the development of these areas during the next few years, mainly because the difficulties confronting agriculture in the Cordilleran region are serious enough to give the prairie lands all the advantage in attracting agricultural colonists and labor. Two facts alone are adequate to support this conclusion. (1) Most of the cultivable lands of the Cordilleran region are forested, and impose on the prospective farmer an expenditure of time, labor, and capital so great that the whole cost of preparing the land for plowing may be greater than would be justified by the expectable returns from its cultivation. (2) A good many tracts, properly classified as arable lands, are for climatic reasons suitable only for hardy cereals (oats, barley, rye), vegetables, and some small fruits; but for such crops there is little demand in that region or any other within reach.

The forest resources are far more significant to the development of the region, for much of the southern half of British Columbia consists of ultimate forest land. The best and heaviest stands are toward the south, in the section tributary to Vancouver. In the central part of the province, especially along the Nechako-Skeena route to Prince Rupert, large tracts of forest now have little or no commercial value. Some large areas have been injured or destroyed by fires, mainly during the last quarter of a century. Other large

areas are covered with a growth of small-sized and inferior spruce, hemlock, and poplar. These forests might be exploited profitably to produce pulp wood, posts, fence rails, railroad ties, and the like, were there a large accessible market for them. Very few tracts of good saw-log timber are found as far north as the fifty-fourth parallel, or the approximate vicinity of the Skeena route. The line tributary to Prince Rupert, therefore, lies near the northern limit of cultivable crops and of valuable commercial forests in British Columbia and cannot derive much advantage from these two resources.

In the matter of mineral resources few deposits comparable to those in the Selkirk and Gold Ranges and other parts of southern British Columbia have yet been found in the more northerly localities, though exploration is likely to reveal new riches; but no great commercial port ever has been developed by traffic resulting from the production of ores alone. The northern section seems quite deficient in supplies of fuels of good trade, as a result of which a serious handicap may be imposed on its mining development as compared with the southern section, where an abundance of high-quality coal is available, such, for example, as the coal from Vancouver Island and the Kootenay region. All the important coal fields now known in British Columbia and nearly all the great coal supplies of Alberta lie within a 500-mile radius of Vancouver, with the greater part of these fields tapped by lines of transportation which naturally are tributary to that Pacific port. On the other hand, only a small part of the coal fields of British Columbia (such as the Telkwa field in the upper Skeena basin) and the northern (poorer) end of the Alberta field lie within a similar radius of Prince Rupert, while from many of these coal areas there are no natural lines of movement tributary to that port. The natural resources in the Cordilleran section, therefore, give an overwhelming advantage to the Vancouver region.

Turn now to a comparison of the prairie regions tributary to the rival ports. The distance from Vancouver is materially shorter than the distance from Prince Rupert to the prairie area which is now developed, or is likely to have any large development in the near future. Thus Edmonton, typical of the northern part of the prairie area, is but 755 miles (Canadian Northern Railway) from Port Mann and is 955 miles (Grand Trunk Pacific Railway) from Prince Rupert. This means, of course, that through all of the strip of prairie country

from the international boundary northward beyond the Athabaska valley, the distance traveled to Vancouver need not be so great as that to Prince Rupert, unless a direct line of railroad is built through Peace River Pass, via the Oslinka to the Skeena. Such a line has not yet been projected.

The southwestern part of the Canadian prairie country, especially that part west of the 105th meridian and south of the Saskatchewan River, is agriculturally less valuable than sections farther to the east and to the north, on account of the scanty rainfall. The development of irrigation projects in the region south and east of Calgary has produced some conspicuous results, as at Lethbridge; but this basis of progress is not at all comparable to the prospects for agricultural development in the more northerly sections without irrigation. Evidently, then, the better parts of the western prairies lie farthest from Vancouver and closest to the passes over the Rockies (Yellowhead and Peace River) by which the Skeena route may be reached. Will this suffice to give Prince Rupert a commercial development greater than that which Vancouver can attain?

The southern prairie section will seek its western outlet mainly via Calgary and the Kicking Horse Pass (Canadian Pacific Railway) through the South Thompson-Fraser route to Vancouver. In spite of heavier grades along that line, any other western Canadian outlet would involve distances so much greater that it could not possibly compete successfully. For the northern section there are two low passes now occupied or in the future presumably to be occupied by railroads to the Pacific. The Yellowhead Pass west of Edmonton is crossed by the Grand Trunk Pacific to reach the Nechak-Skeena route to Prince Rupert, and by the Canadian Northern to reach the North Thompson-Fraser route to Port Mann. The Yellowhead Pass offers the natural western exit from much of the good prairie section north of the Red Deer River and from all the section about Edmonton and north through the Athabaska country. The Peace River Pass, about 250 miles to the north, presumably will be crossed by a railroad which will serve as the logical western exit from that most northerly agricultural region, via the Parsnip either to the main Fraser or to the Nechako-Skeena route or via the Oslinka to the northern Skeena (Map 2).

From these two passes, Yellowhead and Peace River, as is not the case with Kicking Horse, routes lead both to Vancouver and to Prince Rupert. The Yellowhead Pass is nearer (200 miles) to Vancouver than to Prince Rupert, while Peace River Pass is nearer to Prince Rupert than to Vancouver. From the Yellowhead, via the North Thompson-Fraser route to Vancouver, grades are lower than via the Nechako-Skeena route to Prince Rupert. Thus, all prairie traffic seeking an exit by the Yellowhead would find shorter distance and more favorable grades to the coast if routed to Vancouver instead of Prince Rupert.

From the Peace River exit, for the future agricultural development in the north, the best railroad route to the coast lies along the Parsnip, into the upper waters of the Fraser (North Fork) above the junction of the Nechako, for which route a railroad (extension of the Pacific Great Eastern) already has been projected. Thus the traffic from the Peace River region, following that route, would find somewhere near Fort George on the Fraser a point from which there are two ways of reaching the coast: westward to Prince Rupert (Grand Trunk Pacific Railway) through the Nechako-Skeena route, and southward to Vancouver (Pacific Great Eastern Railway) through the main Fraser route.[1]

With approximate equality of distance, the southern route has a distinct advantage in handling traffic from the dividing point at Fort George.

It is necessary, now, to take into account the destinations of western Canadian products, for the coastwise distance between Vancouver and Prince Rupert might offset the advantage of taking goods to the port nearer foreign destinations. It already has been noted that Prince Rupert is nearer to Alaskan and northern Oriental markets, while Vancouver has the advantage in the case of southern Pacific and Atlantic markets. The comparative importance of these respective areas as destinations for Canadian staple exports is so well known that it needs little discussion. Agricultural products,

[1] The Pacific Great Eastern leaves the main Fraser route at Lillooet, above the junction of the Thompson, and crosses two low divides to reach the Cheakampus River and Montagu Channel (Howe Sound), which are followed to North Vancouver. This saves some mileage but, more important, avoids the narrow lower Fraser valley, already followed by two railroads, with little room for another.

lumber, and minerals from western Canada, all find their best markets in Atlantic and southern Pacific localities. For a long time to come, if not permanently, this condition will exist. There is, then, a strong likelihood that the bulk of the traffic, even from the more northerly part of the prairies, will be drawn toward Vancouver, because of favorable distances for the land haul, easy railroad grades, and location of the port with respect to principal foreign destinations. Even for traffic moving to Oriental markets it is not impossible that the saving of more than 200 miles in land haul would more than offset the shorter ocean carriage from Prince Rupert, 480 miles nearer Yokohama than is Vancouver.

There is left to consider only the effects of incoming traffic on the development of these two commercial centers. It has been claimed repeatedly as one of the assets of Prince Rupert that its trans-continental railroad connections offer the shortest possible line of communication between the Far East and Eastern Canada or Western Europe and that this possibility of expeditious transportation ought to make the place an important center for handling Oriental wares for Canada, the United States, and Western Europe. The savings of distance and time, however, compared with other routes from the Far East, are not great enough to weigh very heavily in the movement of anything except mails, perhaps passengers, and possibly the highest class of package freight. The area which can be served most easily by Prince Rupert, as an import center, now has and for a long time presumably will have only a rural population with but little demand for Oriental wares. There is small chance, therefore, for the immediate development of an import trade of any large proportions through Prince Rupert from China and Japan. The best prospect for the development of import trade at Prince Rupert is to be found probably in the fresh-fish traffic from northern British Columbia and Alaskan waters to markets in Canada and the United States. In that respect, Prince Rupert has a distinct advantage over any other Pacific port, because of the saving of time in transit for a perishable commodity; but, judging from other fishing centers, that activity is not likely to contribute greatly to the commercial development of Prince Rupert.

Vancouver, on the other hand, is close to more important centers of population both in Canada and in the United States with increas-

ing demands for Oriental wares, the handling of which will, as heretofore, contribute materially to the commercial progress of that center. Of late years one of the large items in the traffic at Vancouver has been raw silk from China and Japan destined largely for factories in the United States. This traffic, for example, proably could not be diverted to Prince Rupert, because of the much longer land haul from the port to the ultimate destination. Thus Winnipeg, the common point on the eastbound journey for all western Canadian lines, is 1,748 miles from Prince Rupert and 1,484 miles from Vancouver. Similarly, other Oriental wares logically would enter in greater amounts through Vancouver, because of established lines of shipping, solidly intrenched commercial relations, and the number and distribution of people composing the market.

Putting together all these considerations of location, distances, character of tributary areas, routes of transportation, and distribution of population, the sum-total of geographic factors affecting the Vancouver center seems to insure it a continuance of prosperous development. On the other hand, the combination of factors affecting the Prince Rupert center is so unfavorable that only very slow and unimportant development seems to be in store for it for years to come.

CHAPTER VIII

THE UNITED STATES

1. THE LAND AND ITS USE[1]

Original Condition of Land Surface. From the viewpoint of land utilization the territory now included in the United States originally comprised the following types:

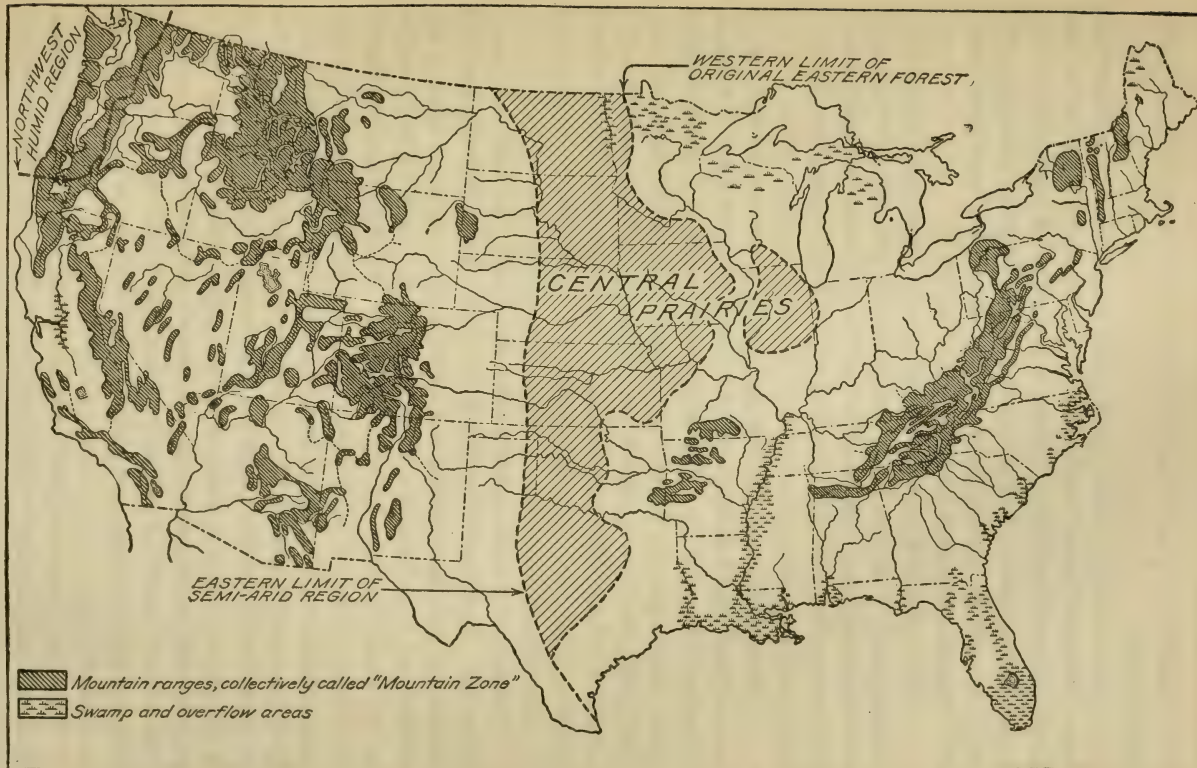
1. The region of the *original eastern forest.* This reaches from the Atlantic on the east to an irregular but fairly definite limit of forest growth on the west. This limit traverses territory now forming parts of the states of Texas, Oklahoma, Kansas, Missouri, Illinois, Iowa, Wisconsin, and Minnesota. (See Map 3, p. 143.) Practically all of this region was originally covered with a fairly dense forest growth.

Three types of growth form the eastern forest. These are (*a*) the *northern mixed growth* (of pine, hemlock, spruce, birch, maple, and other trees) reaching from the "Northwoods" of Maine through New York and Ontario to the northern Lake States; (*b*) the *central hardwoods* (of oak, ash, elm, and many other species) reaching from southern New England through Pennsylvania into the Ohio Valley and adjoining States; (*c*) the *southern conifers* (of hard pine in the uplands, and cypress in the swamps) reaching along the Atlantic and Gulf coastal plain.

Three types of topography occur in the region of the eastern forest. One of these consists of the plateaus and mountain ranges of the Appalachian Highland. Another type of topography consists of the swamp and overflow land and extensive river bottoms; these occur on the Atlantic and Gulf coasts, in the lower Mississippi Valley, in northern Minnesota, and elsewhere. The third type consists of the rolling intermediate land, forming the bulk of the region.

2. The *central prairies* lying between the region of the original eastern forest and the semiarid region of the West. These form a

[1] Adapted from Benton MacKaye, *Employment and Natural Resources*, Department of Labor, Office of the Secretary, 1919, pp. 35–54.



MAP 3.—CHIEF PHYSICAL FEATURES

Original condition of the territory of the United States

level to rolling, treeless area, except for deciduous growth along the river courses.

3. The *semiarid region of the West* (including the smaller *arid* region of the extreme Southwest). This covers the bulk of the area having an annual precipitation under 20 inches; it reaches from California on the west to a line roughly parallel with the one hundredth meridian—about the middle of the country. The "sagebrush country" characterizes most of the semiarid region.

4. The *northwest humid region,* lying in western Oregon and Washington. This region has an annual precipitation of from 30 to 100 inches and more. It includes both mountain and lowland zones. The western flank of the Cascade Range has the highest annual rainfall in the country.

5. The *mountain zone* (east and west), as shown on the map, is more or less mixed in with the other physical features. The main ranges of this zone are: The northeastern ranges (the White and Green Mountains in New England and the Adirondacks in New York); the southern Appalachians (from Pennsylvania to Alabama); the Ozarks (in Missouri and Arkansas); the southern and the northern Rockies; the Sierras of California; the Cascades of Oregon and Washington; and the Coast Ranges along the Pacific.

The forest growth varies greatly in different parts of the mountain zone. The heaviest growth of the country goes with the heaviest rainfall of the country—on the western flank of the Cascades (in Washington and Oregon). The chief tree here is the giant Douglas fir. A heavy growth (of sugar pine and other conifers) occurs in the Sierras; another fairly heavy growth (bull pine and other conifers) occurs in the northern Rockies, and a lighter growth of timber (pine and spruce) occurs in the southern Rockies. Practically no hardwoods occur on the western side of the country. The main body of hardwood timber is in the southern Appalachians. These mountains contain tulip poplar, oaks, hickories, and other valuable woods. The Ozarks contain a mixture of hardwoods and pine; the northeastern ranges grow spruce, maple, birch, and the other trees of the northern forest.

Transition from Original Condition to Present Land Utilization. The physical features which have been described and shown on Map 3 apply especially to the original condition of the United States

and before the land area was put to any extensive utilization. The difference between the original and the present condition of this land area is, of course, a very marked one. The transformation which has taken place began with the first clearings made in the forests along the Atlantic coast by the early English settlers. For two centuries after these first clearings, however, only a trivial impression was made upon the original American landscape and upon the vast resources of the continent. French, Spanish, and British explorers penetrated various parts of the continent from both the Atlantic and Pacific sides; various claims were made for the respective mother countries; and the original thirteen British colonies became established from New Hampshire to Georgia. One of the world's greatest empires lay all but untouched at the time the American Republic was making its start in life. This empire was to become, almost every acre of it, the actual property in fee of the new American State, and the history of this State has been in large measure the story of the settlement of its "public domain."

Migration of the Lumber Industry. The spread of the population from the Atlantic seaboard into the Ohio Valley and elsewhere resulted, of course, in leveling a large portion of the original eastern forest. Much of this forest was cut off, not to produce lumber, but simply to clear the ground for agriculture. For lack of market the finest kind of hardwood timber in the Ohio Valley was cut and burned in the pile by the early settlers. Thus a large part, and perhaps the most valuable part, of the central hardwood forest was thrown away. The clearing of the forests by the settlers, therefore, was usually no part of the lumber industry.

The lumber industry has migrated from east to west along with the country's general development. The original home of the American lumber industry may be said to be in Maine, the old "Pine Tree State." Until the 1870's Maine and the other Northeastern States continued to cut the largest percentage of any region in the country. In 1850 this region produced more than half of the total lumber made in the Nation. By 1880 its proportion had fallen to about one-fourth and at present is less than one-tenth. Lumbering in Michigan and the Lake States got going about the middle of the century, and the proportionate cut of this region rose steadily until about 1890. During the last quarter of the century

it was the main seat of the lumber industry. Since 1900 the cut has sharply declined, and at present the proportion is about that of the Northeastern States, 10 per cent. But during (and before) this decline, the cut of the southern region had been steadily rising, and at present the main seat of the industry is in Louisiana and adjoining States. The cut is about half that in the Nation. The decline of the cut in this region will soon be at hand, and then the industry will be centered in the Pacific States, where the cut has been gradually rising since 1880. At present about one-fifth of the nation's lumber comes from these states.

Thus the lumber industry has been, and still is, passing over the country in a series of waves. Except for a few virgin patches here and there the whole of the original eastern forest has been cut over and about half of it has been entirely cleared for agriculture. Most of the forests of the West, however, are still in virgin condition, especially in the mountainous sections.

Present Land Utilization. The present land utilization of the United States is shown on Map 4. This utilization is here indicated by means of six classes of territory, as follows:

Class 1 Territory. Of this, more than 75 per cent consists of land improved for farming, i.e., either cultivated or used for pasture; the remainder (being less than 25 per cent) consists of one or more of several kinds of land—woodland, cut-over timberland, swamp land, unbroken prairie, range, and waste land. The bulk of this Class 1 territory, as shown on Map 4, is contained in the grain belt extending from Ohio through the Central States into the Dakotas. Isolated portions of this class occur as far east as New York, as far south as Texas, and as far west as California. Small portions of it are dotted throughout the Far Western States, where land has been reclaimed through irrigation.

Class 2 Territory. Of this, not less than 50 nor more than 75 per cent consists of land improved for farming; the remainder (not less than 25 nor more than 50 per cent) consists of the other kinds of land above enumerated. The bulk of this Class 2 territory is contained in areas surrounding the grain belt and other portions of Class 1.

Class 3 Territory. Of this from 25 to 50 per cent is improved; the remainder (50 to 75 per cent) being as above enumerated. In this class, then, there is more unimproved land than improved land.

Map 4.—Present Land Utilization

This map is based upon data from the United States Census, 1910, *Statistical Atlas;* and upon topographic map studies

1. More than 75 per cent, improved for farming; remainder (less than 25 per cent), woodland, cut-over, swamp, unbroken prairie, range and waste land
2. From 50 per cent to 75 per cent, improved for farming; remainder (from 25 per cent to 50 per cent) woodland, cut-over, swamp, unbroken prairie, range, and waste land
3. From 25 per cent to 50 per cent, improved for farming; remainder (from 50 per cent to 75 per cent), woodland, cut-over, swamp, unbroken prairie, range, and waste land
4. Less than 25 per cent, improved for farming; remainder (more than 75 per cent), woodland, cut-over, swamp, unbroken prairie, range, and waste land
5. Territory, less than 20 per cent in farms; remainder (more than 80 per cent), grazing land, timbered, cut-over, swamp, and desert land
6. Territory within Mountain Zone: more than 90 per cent timbered land, cut-over, range, and barren land; remainder (less than 10 per cent), improved for farming

More than half of the area here consists either of unimproved farm land, of farm woodland, or of land entirely outside of farms. This Class 3 territory, as seen from the map, occurs in many regions. In New England, New York, and Pennsylvania the unimproved portions are largely farm woodland; on the Atlantic and Gulf coastal plain they are largely farm woodland and cut-over timberland outside of farms; in Texas they are largely unbroken prairie and range lands.

Class 4 Territory. Of this less than 25 per cent is improved; the remainder (more than 75 per cent) consists of the various kinds of unimproved land. In the state of Maine the unimproved portions are found chiefly in the second growth woodlands outside of farms, while elsewhere in the Northeast they are included mostly in the farm woodlands. In the Lake States the unimproved portions are for the most part the cut-over timberlands; on the Atlantic and Gulf coastal plains, the cut-over and swamp lands; on the great plains from Texas to the Dakotas, the unbroken prairie and range lands; on the Pacific coast and generally in the West they consist mainly of range lands.

Class 5 Territory. Of this less than 20 per cent is in farms; the remainder (more than 80 per cent) consists of grazing land, timbered, cut-over, swamp, and desert land. The bulk of this Class 5 territory lies in the "semiarid region" of the Far Western States; here it consists chiefly of land used or usable for grazing stock, though large parts of it are permanent desert land. A portion of this class occurs also in the northern Lake States, where it consists chiefly of timbered, cut-over, and swamp lands. Another portion occurs in Florida, where it consists in the main of swamp and timbered land. A small but important portion of this Class 5 territory occurs in the Puget Sound region of western Washington, where it consists mainly of Douglas fir land—part of it heavily timbered and part logged off.

Class 6 Territory is contained within the "mountain zone" (east and west). More than 90 per cent of it consists of timbered, cut-over, range, and barren land; the remainder (less than 10 per cent) is improved for farming. With the exception of parts of the eastern mountain ranges in Pennsylvania and neighboring states, this Class 6 territory coincides with the "mountain zone."

The present land utilization of the United States, indicated graphically on Map 4, is shown by means of approximate acreages in Table XXI. This table shows the area of the United States according to certain *present* land classes and geographic divisions.

TABLE XXI[1]

AREA OF THE UNITED STATES BY PRESENT LAND CLASSES AND GEOGRAPHIC DIVISIONS

(All areas are given in million acres.)

Geographic Division	Aggregate Land Area A	Land in Farms			
		Total B	Improved C	Unimproved D	Woodland E
Total United States...	1,903.3	878.8	478.4	209.6	190.8
New England............	39.6	19.7	7.3	4.5	7.9
Middle Atlantic..........	64.0	43.2	29.3	4.6	9.3
East North Central.......	157.0	117.9	88.9	10.9	18.1
West North Central.......	326.5	232.7	164.3	50.4	18.0
South Atlantic............	172.7	103.8	48.5	6.5	48.8
East South Central.......	115.0	81.5	43.9	5.3	32.3
West South Central.......	275.0	169.2	58.3	66.9	44.0
Mountain................	550.0	59.5	15.9	39.5	4.1
Pacific..................	203.5	51.3	22.0	21.0	8.3

These land classes require some brief explanation:

The area of the country is first divided into "land in farms" (46 per cent) and "land not in farms" (54 per cent).

[1] The figures given in Tables XXI and XXII are very rough estimates which have been compiled by comprising somewhat conflicting figures taken from the following sources:

Bowman, Isaiah: *Forest Physiography.*

Bradfield, Wesley: "Standing Timber in Woodlots," *Report of the National Conservation Commission* (1908), Vol. II. pp. 181–90.

Greeley, W. B.: "Reduction of Timber Supply through Abandonment or Clearing of Forest Lands." *Ibid.*, pp. 633–44.

Local State and County Records.

U.S. Census, 1910, Vol. V, *Agriculture, and Statistical Atlas.*

Zon, R: "Future Use of Land in the United States," *Circular 159, Forest Service. U.S. Department of Agriculture.*

Improved land in farms—including both cultivated and pasture land—covers about one-fourth of the total area of the country, and one-half the area in farms. It covers about 478 million acres, as shown in column C. Of this acreage about 50 per cent is in the grain belt above mentioned and 20 per cent in the southern coastal plain.

Unimproved land in farms consists of the unbroken fields, the neglected fields, the "brush lots," the "stump lots," the undrained marshes, the sand plains, and the other waste spaces found within

TABLE XXII

Geographic Division	Land Outside of Farms				
	Total F	Timber, cut-over, and swamp lands* G	Irrigable H	Range I	Barren and Other J
Total United States...	1,024.5	394.2	40.0	510.0	80.3
New England............	19.9	18.9	....	....	1.0
Middle Atlantic..........	20.8	18.2	....	....	2.6
East North Central.......	39.1	36.0	....	....	3.1
West North Central.......	93.8	28.3	2.3	58.3	4.9
South Atlantic............	68.9	66.1	....	....	2.8
East South Central.......	33.5	31.8	....	....	1.7
West South Central.......	105.8	37.6	2.6	61.6	4.0
Mountain................	490.5	91.4	23.1	329.9	46.1
Pacific..................	152.2	65.9	12.0	60.2	14.1

*The swamp lands here included are for the most part covered by some form of forest growth.

the farm bounds. This land covers nearly 210 million acres (column D). Of this acreage nearly 50 per cent consists of unbroken fields and prairie land in the Great Plains region from the Dakotas to Texas.

Woodland in farms covers 191 million acres (column E). Of this acreage about 65 per cent is in the Southern states and 20 per cent in the North Central states.

The remaining land classes are outside of farms.

Timber, cut-over, and swamp lands cover nearly 395 million acres (column G). Data are not available for separating, in any reliable way, the three types of land comprised in this class.

At least a fourth of the above acreage is covered by virgin timber, this being chiefly in the Rocky Mountain and the Pacific States. Most of the forest areas, however, have been cut over to greater or less extent, the cuttings varying from light culling to complete "skinning." The cut-over lands, therefore, vary from "stump-lands" to areas fairly heavily timbered.

The permanent swamp land here included covers nearly 53 million acres, according to studies made by the Department of Agriculture. Most of this is covered more or less by forest growth, though a portion of it consists of open marsh land.

An extra area (*not* here included) consists of wet grazing land and of other lands which become periodically swampy or overflowed. The Department of Agriculture estimates this area to be about 26 million acres, which, with the above acreage of permanent swamp, makes a total of 79 million acres of wet lands in the country. Seven-tenths of these wet lands are in the Southern states and half of the remainder in the northern Lake states.

The *irrigable* area (column H) covers 40 million acres along the valleys in the western half of the country. Probably less than half of this is in the remaining public domain. In addition to this irrigable area, it is estimated that about 20 million acres have already been irrigated. The 1910 Census places the irrigated acreage at 13,738,000, distributed among the various geographic divisions as follows: West North Central, 367,000 acres; West South Central, 169,000 acres; Mountain, 9,518,000 acres; and Pacific, 3,684,000 acres.

The *range* covers 510 million acres, or over one-fourth of the total area of the country (column I). This consists of land actually used for open grazing outside of farm units, or else capable of such use to greater or less extent. Most of it is in the "semiarid region," though many million acres of it occur in the western mountains, mixed with the forest growth.

The "*barren and other*" *land* covers about 80 million acres (column J). This class consists chiefly of the permanently barren land scattered throughout the country. The largest single body of such land is in the Arizona and California desert. Many patches of desert land also extend through the Great Basin and elsewhere in the semiarid region. Permanently barren areas consist also of the alpine crests of most mountain ranges, of swamps that can not

profitably be drained, of sterile sand plains unfit even for forest growth and of other waste places which for one reason or another are unreclaimable. In addition to the barren land, there are upward of five million acres occupied by cities and towns, besides a small percentage used for mining operations and miscellaneous purposes not named above. Such areas, together with the unreclaimable barren places, constitute this class of "barren and other" land.

2. CONDITIONS AFFECTING THE UTILIZATION OF THE LAND IN THE UNITED STATES[1]

Topography. Several conditions must be met in order that land may be adapted to the production of crops. First, in this country, land generally must not be so stony or hilly as to prevent the use of the plow and other farm machinery. Vast areas in the western part of the United States and smaller areas in the Appalachian Mountains of the East are not in farms because of their rough surface. Probably 350,000,000 acres, or nearly one-fifth of the land area of the United States, is too hilly or rough for the successful production of crops. This mountainous or stony land, where the rainfall is sufficient, is adapted to the growth of forests, and where the rainfall is light is grazed by roving flocks of sheep or by cattle.

Rainfall. Secondly, the rainfall must be sufficient for profitable production of crops. Map 5 shows the average annual precipitation (rain, melted snow, sleet, and hail) in the United States, and helps to explain why farms are absent from much of the land level enough for agriculture west of the one hundredth meridian. Where the average annual precipitation in Montana is less than 12–15 inches, or less than 18 inches in eastern Colorado, 20 inches in the Panhandle of Texas, and 25 inches in the lower Rio Grande Valley of Texas, the production of crops without irrigation becomes a precarious business under present conditions. This minimum rainfall requirement for successful crop production ranges from 9 to 30 inches in different parts of the United States according to local climatic and soil conditions. In general, it increases from north to south with increasing

[1] Adapted from O. E. Baker and H. M. Strong, "Arable Lands in the United States," *Yearbook of the Department of Agriculture*, 1918, pp. 433–41. Mr. Baker is agricultural economist in the Office of Farm Management, United States Department of Agriculture. Dr. Strong is assistant professor of geography at the University of Missouri.

evaporation and less favorable seasonal distribution of precipitation. Probably 600,000,000 acres, or nearly one-third of the land area of the United States, receives insufficient rainfall for the profitable production of crops at normal prices, and possesses no possibilities of irrigation. In occasional years of heavier rainfall, large profits may be made by growing crops in these semiarid regions, but in the long run it pays better in most localities to use such land for grazing.

Growing season. Thirdly, the amount of heat must be sufficient and the season between killing frosts long enough to mature crops. Map 6 (p. 154) "Average Length of Growing Season," shows that over a large extent of elevated land in the West, and also in the Adirondacks and a portion of northern Maine, the average growing season is less than 90 days, and frosts may occur during the summer. Light frosts are not, however, seriously injurious to certain hardy crops, and there is very little area in the United States otherwise suitable for crops where the small amount of heat received or shortness of the growing season prevents the successful production of hay and certain varieties of barley, oats, spring wheat, and potatoes.

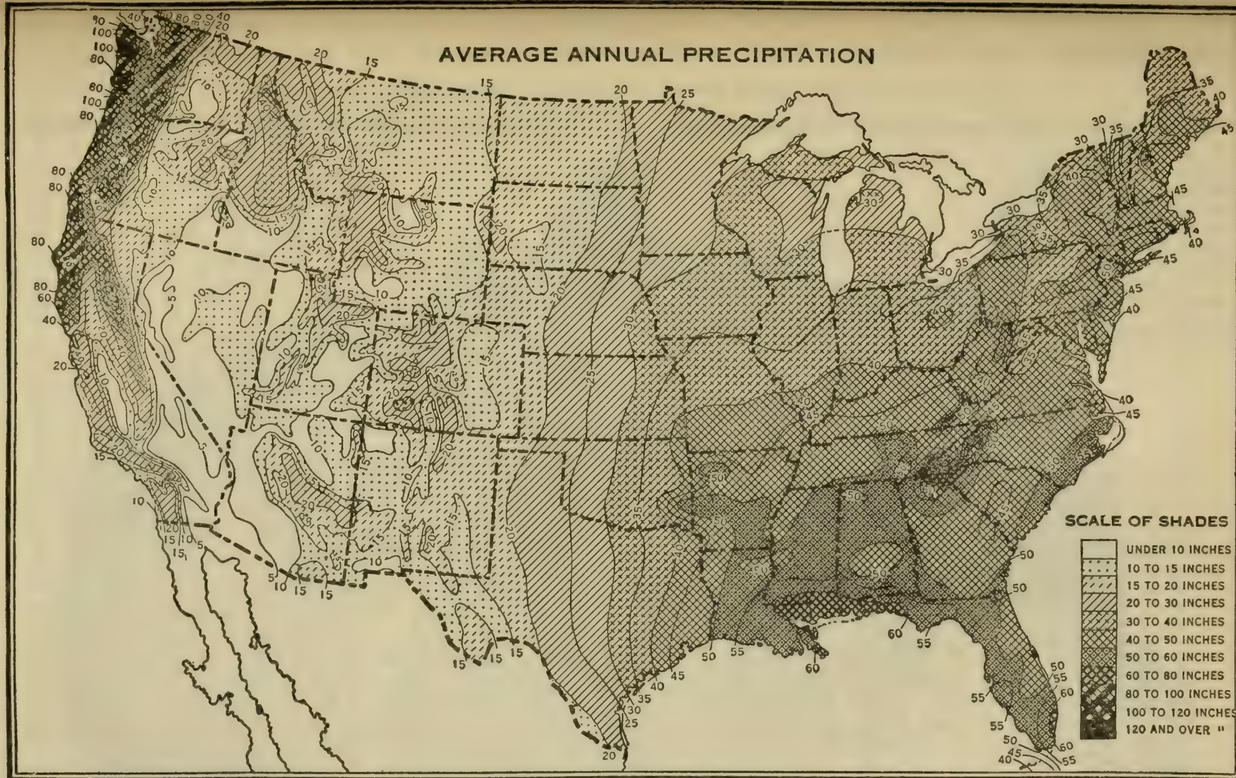
Soil. Lastly, there are in the United States considerable areas of land where the soil is too sandy or infertile for the profitable production of crops at prevailing prices. Such soils are better adapted to forest, and when cleared for agricultural use are generally soon allowed to grow up again to brush and trees.

In all, about 1,000,000,000 acres, or more than one-half of the land area of the United States, is unfitted for the profitable production of crops, owing either to rough topography, deficient rainfall, low temperature, or infertile soil. This land, except about 40,000,000 acres of absolute desert, is used, though often not as fully as it might be, for the production of wood and timber and for grazing live stock.

Potentially Arable Land. In addition to these largely irremediable conditions which limit the expansion of crop area in the United States, there are other natural conditions amenable to improvement which have retarded agricultural development over large areas.

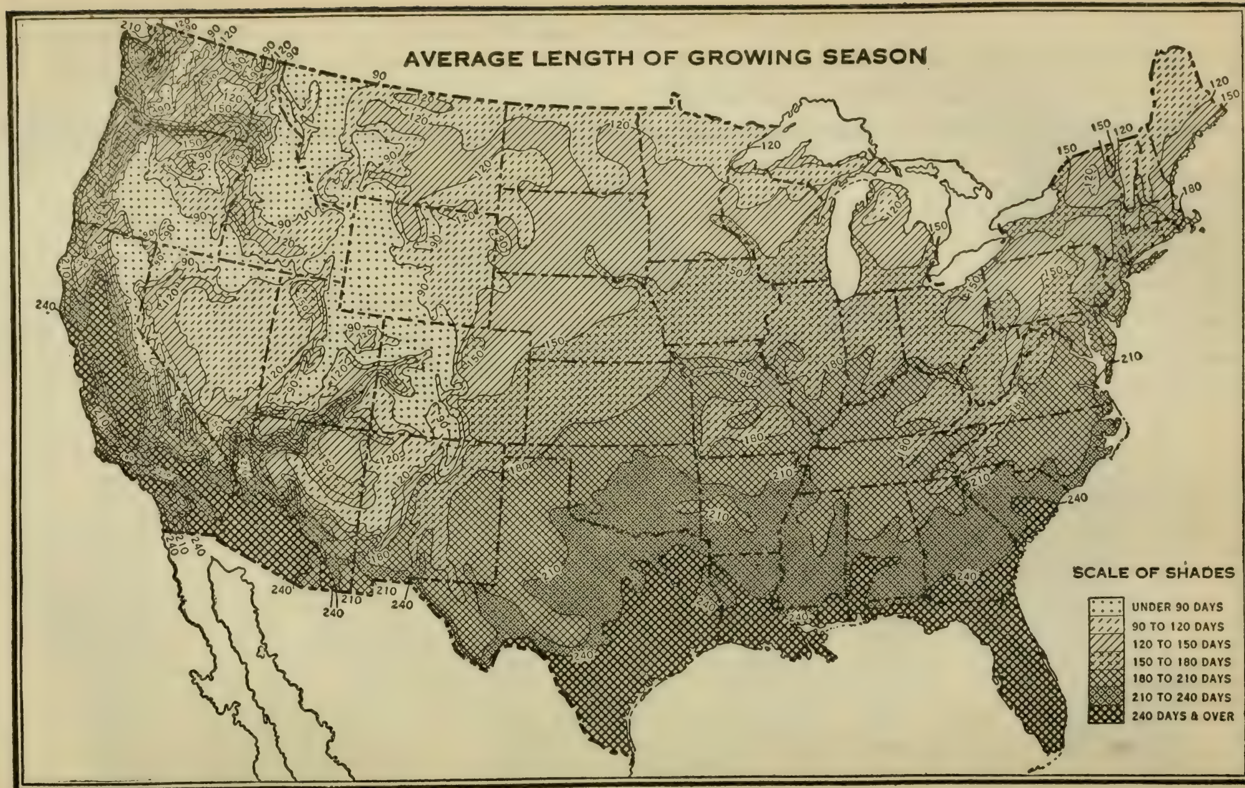
Forest and Woodland. Map 7 shows the location of the forest and woodland area of the United States in a generalized way. Much of this area will be utilized for farming in the future.

In the northern sections of Michigan, Wisconsin, and Minnesota, and along the north Pacific Coast, there is much forest and cut-over



Map 5.—Average Annual Precipitation (rain, melted snow, sleet, and hail)

This map is much reduced and generalized from a map prepared by the United States Weather Bureau for publication in the Precipitation and Humidity section of the *Atlas of American Agriculture.*



MAP 6.—AVERAGE LENGTH OF GROWING SEASON BETWEEN KILLING FROSTS

This map is much reduced and generalized from a map prepared by the United States Weather Bureau and published in the Frost and Growing Season section of the *Atlas of American Agriculture*.

land which can be and is being made into farms, but at great expenditure of labor. In the South, from Virginia and the Carolinas to central Texas, a vast amount of cut-over land and woodland is being redeemed gradually for agriculture. It may be estimated that about 200,000,000 acres of forest, cut-over land, and woodland in the United States, including that in farms, could be used for crops after clearing, or more than one-tenth of the land area of the country.

If all this agriculturally suitable forest and cut-over land were made into farms averaging 160 acres in size, it would provide 1,250,000 farms, an addition of about 20 per cent to the total number of farms in the country. These wooded areas constitute the greatest unreclaimed agricultural resources of the nation, but the development of these lands must necessarily be slow, and should be undertaken only by men accustomed to hard labor and willing to endure privation. It is unlikely that more than 50,000,000 acres, or enough for perhaps 300,000 farms, will be cleared by the present generation of farmers, unless the government assumes responsibility.

Swamps and Other Wet Lands. The next greatest undeveloped agricultural resource of the country is to be found in the swamps and other wet lands susceptible of drainage. It has been estimated that there are some 60,000,000 acres of such land suitable for the production of crops after reclamation, or enough to make 1,000,000 farms of 60 acres each of improved land. This land is located largely in the Mississippi River bottoms and other river bottoms of the Coastal Plain of the South, and in the peat bogs and muck lands of the glaciated Lake States and Northeastern States. It is for the most part potentially fertile land. But drainage is an expensive operation, often involving co-operative or capitalistic effort, and will require time, very likely a half-century or more, for the complete development of the 60,000,000 acres. Practically none of this land is available for settlement at present.

Irrigable Land. The third opportunity for expansion of our agricultural area is found in the potentially irrigable land awaiting development in the Western States, estimated at 30,000,000 acres if all available sources of water supply were fully utilized (see Map 8). This is double the present area of irrigated land, and would provide 340,000 farms averaging 87 acres in size, which is the average acreage per farm of irrigated land as shown by the Census of 1910. But the

cost of construction of dams in the mountains and of irrigation canals and ditches is very great and becomes progresssively greater as the less favorable projects are developed. At present the supply of land under the ditch and ready for farming in several federal reclamation projects exceeds the demand at the price quoted, which in many cases includes only the cost of development. It appears likely, therefore, that the development of these potentially irrigable areas will require many years, and in the end will provide fewer farms than either the forest and cut-over lands, or the swamp and overflow lands. In 1910, about 160,000 farms in the western states were irrigated in whole or in part, and the slight increase since that date has been confined principally to the federal reclamation projects, upon which there are now (1918) about 27,000 farmers.

Unimproved Land Other than Woodland. A different type of land, some of which will be utilized gradually for the production of crops, is that in our eastern farms classified in the census report as "unimproved land other than woodland." This land consists largely of unused fields, stony upland pastures in hilly regions, and parcels of waste land, and includes in all about 50,000,000 acres in our humid eastern states. Some of this land has been in crops in the past, constituting in part the so-called abandoned farms, and if prices of farm products continue high and farm labor again becomes comparatively cheap, a portion of this land will undoubtedly be put into crops, though probably never more than two-thirds, or perhaps 35,000,000 acres.

Dry Farming. Finally, the further development of dry farming may make room for a few more farmers in the West. Under the 640 acres grazing homestead act passed in 1916, somewhat over 45,000 applications had been made and approved by October 1, 1918. In the opinion of those best informed, most of these grazing homesteads which afford promise of supporting a family have been applied for.

Total Arable Land. According to the best information, we have in all about 850,000,000 acres of land at present in crops and potentially available for the production of crops. This is 45 per cent of the total land area of the United States, or about the same proportion the arable land of France is of the total area, and some 5 per cent less than the proportion of the land in Germany that is arable. In view

MAP 7.—GENERAL LOCATION OF THE FOREST AND WOODLAND AREA OF THE UNITED STATES

This map was prepared in co-operation with the Forest Service. In the West, except in Oregon and California, the boundaries of the forests have been taken in part from a map prepared by Henry Gannett and published in the *Nineteenth Annual Report of the U.S. Geological Survey*. In Oregon and California maps issued by the state departments of forestry were used.

MAP 8.—LOCATION OF IRRIGATED AREAS IN THE WESTERN STATES

This map is much reduced and generalized from state maps prepared by the Census Bureau and then checked and corrected by the state irrigation engineers upon the request of the Office of Irrigation Investigations, United States Department of Agriculture. Most of the areas necessarily have been exaggerated, so that the map presents a picture, sufficiently accurate for a general conception, of the potentially irrigable as well as the present irrigated areas.

of the fact that these countries have practically no semiarid area, such as covers about one-third of the United States, it seems probable that this estimate of the total arable land of the United States, although smaller than those made heretofore, is too high rather than too low.

Of these 850,000,000 acres, nearly 480,000,000 acres were "improved" in 1910. The remainder consists of about 200,000,000 acres of potentially arable forest and cut-over land, of which probably more than one-half is at present included in the 190,000,000 acres of woodland in farms; 60,000,000 acres of swamps and other wet lands awaiting reclamation by drainage; 30,000,000 acres of potentially irrigable land; and about 80,000,000 acres of other lands, mostly "unimproved land other than woodland" in eastern farms and dry-farming land in the West.

These undeveloped lands may provide eventually about 3,000,000 farms, an increase of somewhat less than 50 per cent over the number of farms in the United States today. But unquestionably the better and the best land which it has been possible to develop by individual effort is now "improved" land in farms, and much of that which remains undeveloped must await the gradual application of large amounts of capital to its development, supplied either by private initiative or by the government.

The 1,000,000,000 acres or more of non-arable land consists of about 360,000,000 acres of absolute forest land; that is, land not adapted to crops but where climatic conditions permit the growth of forests; 615,000,000 acres of grazing land, practically all in the western states; and 40,000,000 acres of absolute desert land. In addition, there are about 40,000,000 acres of land at present in cities, rural highways, and railroad rights of way, an amount which will gradually increase with increasing population.

Economic Aspects. All these estimates refer merely to the potential fitness of the land for agriculture, and do not take into account economic aspects of the subject. It may be found, for instance, that 360,000,000 acres of forest will not be sufficient to supply the needs of the nation for forest products, and that some of the lower grades of potentially arable land can be more profitably utilized for the production of timber. In fact, assuming that the annual per capita consumption of forest products will gradually decrease to half that at present, a very conservative estimate, and allowing a very liberal

estimate of the rate of growth of forests under intensive management (33 cubic feet per acre per annum), the country will require a woodland area of at least 450 million acres for a population of 150 million people. It does not seem likely, therefore, that the forest area will ever be reduced to 360 million acres, but that there always will be considerable potentially arable land, mostly of poor quality, in forest, as is the case in the well-developed countries of Europe today. Similarly it is practically certain that an appreciable proportion of the land suitable for crops will be kept in pasture. At present the ratio of improved pasture to cropped land in the United States is about one to four, and in many older and more highly developed agricultural regions, especially those of England and northern France, the proportion in pasture is much greater.

Also it should be kept in mind that probably half of the 370,000,000 acres of reclaimable arable land is at present in farms, and that most of this land in farms is unlikely to need the assistance of the government in its reclamation. Farmers who live in forested regions commonly clear off a few acres of timber each winter, and some who have poorly drained meadows or fields put in a few lines of tile each year. In this way, and also by plowing up pasture lands for crops, the area in staple crops increased 37,000,000 acres between 1914 and 1918, according to a recent estimate of the Bureau of Crop Estimates, an increase of nearly 10 per cent, which is much greater than the percentage increase in the population of the nation. This four-year increase in acreage of the staple crops is equivalent to the acreage of all crops in 1910 in the New England states, New York, Pennsylvania, New Jersey, Delaware, Maryland, West Virginia, Virginia, and North Carolina.

Increased production of agricultural products may also be expected to come from more intensive farming. The yields per acre of the staple crops, with the possible exception of corn, have shown a general tendency upward during the last twenty-five years.

High prices of agricultural products result in improved methods and increasing intensity of culture, as well as in making possible the cultivation of less desirable lands. Both methods of increasing production should be and will be used; but in many cases the application of more capital and labor to land now in use will bring greater returns than the use of the same capital and labor in the development of new lands.

It appears probable, therefore, that the area in crops will never reach the estimated possible total of 850 million acres, but that with increasing cost of reclamation, the trend will be toward more intensive cultivation of the more fertile or favorably situated land and use of the lower grades of arable land for grazing or production of timber. This trend is illustrated in the northeastern states by the well-cultivated lowlands and the so-called abandoned farms in the highlands. Farms close to good markets can be bought in these states for less than the cost of the buildings. In the densely populated and highly developed countries of northwestern Europe, where an

TABLE XXIII

Yield in Bushels Per Acre of Six Leading Food Crops in the United States, Five-Year Averages for 1866–70 to 1900–15*

Years	Corn	Wheat	Oats	Barley	Potatoes	Rye
1866–70	25.4	11.9	28.6	24.3	94.4	13.5
1871–75	26.8	11.9	28.1	21.5	91.5	13.6
1876–80	27.1	12.9	27.6	22.7	85.3	13.9
1881–85	23.6	11.8	26.8	21.7	77.2	11.9
1886–90	23.7	12.1	25.2	21.8	68.7	11.7
1891–95	23.6	13.4	26.2	23.4	77.7	13.7
1896–1900	26.0	13.2	28.6	23.4	81.0	14.5
1901–5	24.9	13.9	31.0	27.0	88.7	15.9
1906–10	27.2	14.6	28.0	24.4	96.9	15.8
1911–15	26.0	15.4	31.7	26.5	98.1	16.5

*Compiled from the reports of Bureau of Crop Estimates, United States Department of Agriculture.

approximately stationary condition has been reached, about half the land area is arable, whereas in the humid portion of the United States about 38 per cent of the land area is "improved"—using the terminology of the Census. As geographic conditions in so far as they relate to the potential utilization of land in the two regions are somewhat similar, it may be anticipated that when the population of the United States becomes as dense as that of northwestern Europe the improved land will be about half of the humid area of the nation, or 600 to 700 million acres.

3. ORIGINAL AND PRESENT FORESTS OF THE UNITED STATES[1]

Original Forest Area. The original forest area of the country is estimated to have been in the neighborhood of 822,000,000 acres.

[1] Adapted from United States Department of Agriculture, Forest Service, *Report on Senate Resolution 311*, pp. 31–34.

(See Table XXIV.)[1] In the eastern United States a magnificent forest of old-growth timber, wonderfully rich in variety of species and quality of material, stretched in an almost unbroken expanse from the Atlantic Ocean to the prairies. Pines and other softwoods predominated in the north and along the Atlantic and Gulf coasts, while in the Appalachians and on the fertile soils of the central states and the lower Mississippi Valley oak, hickory, ash, chestnut, yellow poplar, and other valuable hardwoods abounded. In the West

TABLE XXIV

Original and Present Forest Areas in the United States in Acres, by Regions

Region	Original	Present	
		Total	Virgin
New England	38,908,000	24,708,000	2,000,000
Middle Atlantic	69,610,000	28,678,000	1,896,000
Lake	103,680,000	57,100,000	10,100,000
Central	170,560,000	56,682,000	7,150,000
South Atlantic and East Gulf	170,240,000	99,000,000	18,300,000
Lower Mississippi	128,400,000	78,865,000	20,835,000
Rocky Mountain	63,720,000	60,842,000	37,746,000
Pacific Coast	77,120,000	57,586,000	39,369,000
Total	822,238,000	463,461,000	137,396,000

practically all of the area not too arid to support tree growth was also covered with a forest of virgin timber interspersed with occasional patches of younger, even-aged stands, as of Douglas fir and western white pine, following fire. Along the Pacific coast the heavy stands

[1] Various terms found in this and other accompanying tables and figures are used with the following meanings:

"Saw-timber areas" and "saw-timber stands" are stands of saw-timber size in accordance with the prevailing logging and milling practice of the region concerned.

"Cordwood areas" and "cordwood stands" are stands not now of sufficient size to produce saw timber under the prevailing local logging and milling practice.

"Non-restocking areas" comprise lands that once supported a stand of timber, which is now gone, and which is not being renewed.

"Virgin areas" and "virgin stands" comprise stands in which there is no net growth, such growth as takes place being offset by loss from decay and other causes. This excludes certain old-growth stands, as, for example, in California,

of redwood, Douglas fir, western hemlock, and western red cedar formed one of the finest forests in the world.

Present Forest Area. Today of the original forest area there remains but little more than half or approximately 463,000,000

TABLE XXV

PRESENT FOREST AREA OF THE UNITED STATES BY REGIONS AND CHARACTER OF GROWTH

REGION	TOTAL (THOUSAND ACRES)	PERCENTAGE	SAW TIMBER (THOUSAND ACRES)		CORDWOOD (THOUSAND ACRES)	NON-RESTOCKING (THOUSAND ACRES)
			Virgin	Growing		
New England...	24,708	5	2,000	8,761	8,372	5,575
Middle Atlantic.	28,678	6	1,896	9,559	10,793	6,430
Lake...........	57,100	12	10,100	13,930	12,570	20,500
Central........	56,682	12	7,150	23,301	24,011	2,220
So. Atlantic and East Gulf....	99,000	22	18,300	27,900	32,080	20,720
Lower Miss.....	78,865	17	20,835	20,200	24,075	13,755
Rocky Mountain	60,842	13	37,746	3,313	14,533	5,250
Pacific Coast*...	57,586	13	39,369	5,292	6,425	6,500
TOTAL.....	463,461	100	137,396	112,256	132,859	80,950

* Complete data for this region not available; total forest area probably some 5,000,000 acres more than indicated.

acres, excluding in both cases from 100 to 150 million acres of low-grade woodland and scrub. (See Table XXV.) Furthermore, so far as the utilization of the original forest progressed that of the total

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which have not been lumbered and are ordinarily regarded as "virgin" forests, but in which a net growth is now taking place as a result of the present protection of such stands following their opening up by fire.

"Growing areas" and "growing stands" include all stands, irrespective of their size, in which current growth is in excess of current loss; that is, in which there is a net growth.

"Saw timber" comprises that portion of the stand on saw-timber areas of sufficient size for manufacture into lumber. Board-feet estimates of saw timber are given in terms of lumber tally rather than log scale.

"Cordwood" comprises that portion of the stand on saw-timber areas not of sufficient size for manufacture into lumber and the entire stand on cordwood areas. It may thus include occasional trees of saw-timber size which occur in cordwood stands but not in sufficient quantity to be lumbered.

"Total stand" includes both saw timber and cordwood.

remaining area, only 30 per cent, or 137 million acres, is virgin forest. The remainder includes 112 million acres of second-growth saw timber, 133 million acres of second growth below saw-timber size, and 81 million acres which are not restocking. Cutting has naturally been heaviest in the most fertile and most densely populated sections of the country. Thus in the central states the original forest has been reduced to one-third of its former extent, while in the Rocky Mountains 95 per cent of it still remains. More than half of the virgin forests of the country are in the western states, only 15 per cent of the virgin forest area being included in the northern and

TABLE XXVI

STAND OF SAW TIMBER IN THE UNITED STATES BY REGIONS

Region	Saw Timber Area (Thousand Acres)	Total Saw Timber		Softwood (Million Board Feet)	Hardwood (Million Board Feet)
		Million Board Feet	Percentage		
New England	10,761	49,799	2	38,480	11,319
Middle Atlantic	11,455	44,857	2	15,353	29,504
Lake	24,030	110,110	5	40,760	69,350
Central	30,451	144,470	7	11,318	133,152
South Atlantic and East Gulf	46,200	220,577	10	136,827	83,750
Lower Mississippi	41,035	280,908	13	148,308	132,600
Rocky Mountain	41,059	223,141	10	223,141	....
Pacific Coast	44,661	1,141,031	51	1,141,031	....
Total	249,652	2,214,893	100	1,755,218	459,675

central states. Over nearly a fifth of the present forest area the original timber growth is not being renewed. The largest areas of non-restocking land are in northern New England, Pennsylvania, the northern Lake states, the pine lands of the South Atlantic and Gulf states, and parts of the Pacific Coast states.

Saw-Timber Stands. The original stand of saw timber has been estimated at not less than 5,200 billion board feet. In the light of the cut that has already been obtained, and of present standards of utilization, it is probable that the actual stand was considerably larger. Even taking the lower figure, however, less than half of the original stand, or 2,215 billion board feet, still remain (see Table XXVI). Of this, some 1,755 billion feet are softwoods and 460 billion

feet hardwoods. Approximately 70 per cent of the total stand, including the best and most accessible timber, is in private ownership, while about 498 billion board feet, or 22 per cent, is included in the national forests. States and municipalities together hold only 59 billion board feet, or less than 3 per cent of the total.

The exhaustion of the eastern forests and the steady progress of the lumber industry toward the West is well indicated by the location of the remaining stands of saw timber. Thus, New England, the Middle Atlantic, Central, and Lake States, with 35 per cent of the total forest area, contain only 349 billion board feet, or 16 per cent of the total; while the Pacific Coast States, with only 13 per cent of the forest area, contain 1,141 billion board feet, or nearly 52 per cent of the total. Between these two extremes come the South Atlantic, East Gulf, and Lower Mississippi States, with 39 per cent of the forest area and 23 per cent of the saw timber; and the Rocky Mountain states, with 13 per cent of the forest area and 10 per cent of the saw timber. Altogether, 61 per cent of the present stand of saw timber lies west of the Great Plains.

In other words, the depletion of our eastern forest resources has now reached the point where the softwood stands in the northern and Central states can no longer contribute any large proportion of the total softwood lumber consumption of the country, where the Southern states are losing the commanding position that they have held for the last 20 or 30 years, and where the one great reservoir of softwood timber still left lies on the Pacific coast, chiefly in the Pacific northwest. Douglas fir, with an estimated total stand of 596 billion board feet, approximately 85 per cent of which is in the two states of Washington and Oregon, is the principal species in the West. Western yellow pine is a fair second, with a total stand of 250 billion board feet, 27 per cent of which is in the Rocky Mountains and 73 per cent on the Pacific coast. Following these two species, which together comprise nearly half of the softwood saw timber in the entire country, come western hemlock, the true firs, and redwood, with stands of 95, 91, and 72 billion board feet, respectively.

In the East the only softwood with a stand comparable to any of these is southern yellow pine, with a total of 258 billion board feet, or slightly more than western yellow pine. Spruce and fir come next, with a stand of 32 billion board feet, followed by hemlock, white and

Norway pine, and bald cypress. The stand of these six species together is considerably less than half as much as the stand of southern yellow pine, and is only 6 per cent of the total stand of softwoods. The total saw-timber stand of white pine, once regarded as "inexhaustible," is now less than the amount estimated to have been manufactured into lumber in either the Saginaw Valley or at Muskegon, Michigan, and less than one-fifth of the total estimated cut from the state of Michigan.

Of the hardwoods the only large reservoirs of virgin timber still left are in the Lake states, the Southern Appalachians, and the lower Mississippi Valley. The first two of these contain, respectively, about 32 and 53 billion feet of old growth. There is also a considerable total stand of hardwoods, estimated at approximately 133 billion board feet, in the Central states outside of the Appalachians, but this is composed chiefly of second-growth material in widely scattered wood lots, and cannot be counted on to contribute any large proportion of high-class material to the hardwood industries. Oak is easily the leading hardwood of the country, with a total stand of 157 billion board feet, followed by the three northern hardwoods—birch, beech, and maple—having together 91 billion board feet. Three of the most valuable hardwoods—hickory, ash, and yellow poplar—together have an estimated stand of only 35 billion board feet, or less than 2 per cent of the total stand. That the depletion of the hardwood supply of the country has progressed even farther than that of the softwoods is indicated by the fact that the hardwoods constitute only about 20 per cent of the saw-timber stand, as against nearly 30 per cent of the saw-timber cut. Moreover, the depletion is particularly marked in the case of the more valuable woods.

Total Stand. The total volume of standing timber in the country, including both saw timber and cordwood, is estimated roughly at 746 billion cubic feet. Of this, 485 billion cubic feet is saw timber and 261 billion cubic feet cordwood.

While the cordwood forms more than one-third of the total volume of standing timber, less than one-sixth of the total is on the cordwood areas, which average only about 850 cubic feet to the acre. This low average is in itself a striking indication of failure to secure a satisfactory restocking of our cut and burned over forest lands. This failure will have increasingly serious consequences, as depletion

of the old-growth forests makes us more and more dependent on second-growth timber.

4. DEVELOPED AND POTENTIAL WATER-POWER IN THE UNITED STATES[1]

Excluding developments of less than 1,000 h.p., the total developed water-power of the United States is 4,016,127 h.p., of which 2,961,549 h.p. is classed as "commercial" power and 1,054,578 h.p. as "manufacturing." That is to say, 74 per cent of the total power from developments of 1,000 h.p. and over is sold by commercial concerns or used by public-service corporations, and 26 per cent is generated and used by manufacturing concerns.

The total developed water-power of the country, including the developments of less than 1,000 h.p., which amount to about 2,000,000 h.p., is, in round numbers, 6,000,000 h.p.

The developed water-power, including only developments of 1,000 h.p. and over, and the potential water-power on a basis of 75 per cent efficiency are shown by states in Table XXVII.

From this table (p. 168) it is seen that California leads with 14.5 per cent of the "commercial power," developed and under construction, followed by New York with 13.4 per cent, Washington with 10.1 per cent, Pennsylvania with 5.7 per cent, Iowa with 5.1 per cent, Montana with 4.7 per cent, South Carolina with 4.6 per cent, Georgia with 4.3 per cent. Ohio has only about 4,000 h.p. developed. Florida, South Dakota, West Virginia, Alabama, Kansas, and New Jersey are next above Ohio with amounts ranging from only 5,000 to 7,200 h.p.

A significant fact brought out in the table is the geographical concentration of water-power owned by manufacturers. The five states of Maine, New Hampshire, Vermont, Massachusetts, and Connecticut have 36 per cent of the developed manufacturing power, and New York has 30 per cent, thus giving to these six states 66 per cent, or nearly two-thirds of all the developed manufacturing power in the country. The developed manufacturing power used in these states is found mainly in paper and pulp and cotton manufacturing. Minnesota and Wisconsin together have nearly 17 per cent of the total

[1] Adapted from *Report of the Commissioner of Corporations on Water-Power Development in the United States*, 1912, pp. 55–56, 61–64.

TABLE XXVII

Developed and Potential Water-Power in the United States by States

State	Developed and under Construction, Concerns of 1,000 h.p. or More			Potential h.p., 75 per Cent Efficiency	
	Commercial	Manufacturing	Total	Minimum	Assumed Maximum
United States	2,961,549	1,054,578	4,016,127	26,736,000	51,398,000
Maine	65,360	168,338	233,698	443,000	809,000
Massachusetts	76,697	53,922	130,619	118,000	228,000
New Hampshire	16,450	103,658	120,108	135,000	246,000
Vermont	53,648	40,197	93,845	94,000	172,000
Connecticut	32,000	15,519	47,519	72,000	137,000
Rhode Island	....	....	....	6,000	13,000
New York	398,058	315,313	713,371	1,037,000	1,698,000
Pennsylvania	169,632	....	169,632	276,000	684,000
New Jersey	7,200	....	7,200	44,000	106,000
Maryland	....	....	....	43,000	122,000
Delaware	....	....	....	5,000	11,000
Virginia	33,700	17,620	51,320	492,000	870,000
District of Columbia	....	....	....	5,000	11,000
West Virginia	5,250	16,150	21,400	381,000	1,051,000
Kentucky	....	....	....	83,000	197,000
Tennessee	62,000	....	62,000	463,000	761,000
South Carolina	135,040	47,457	182,497	460,000	677,000
Georgia	126,927	12,350	139,277	374,000	627,000
North Carolina	82,960	14,050	97,010	578,000	875,000
Alabama	6,000	10,450	16,450	509,000	943,000
Florida	5,000	....	5,000	8,000	13,000
Mississippi	....	....	....	32,000	63,000
Louisiana	....	....	....	1,000	2,000
Arkansas	....	....	....	22,000	61,000
Texas	....	....	....	255,000	551,000
Oklahoma	....	....	....	75,000	208,000
Wisconsin	96,799	106,153	202,952	358,000	670,000
Michigan	102,682	30,420	133,102	180,000	293,000
Illinois	38,460	12,751	51,211	192,000	345,000
Indiana	10,425	4,250	14,675	43,000	118,000
Ohio	4,025	....	4,025	59,000	178,000
Minnesota	95,815	72,200	168,015	232,000	494,000
Iowa	151,400	....	151,400	160,000	382,000
Kansas	6,800	....	6,800	111,000	269,000
South Dakota	5,000	....	5,000	43,000	75,000
Missouri	....	....	....	72,000	163,000
North Dakota	....	....	....	88,000	207,000
Nebraska	....	....	....	196,000	366,000
Montana	139,260	....	139,260	2,749,000	4,331,000
Colorado	69,690	....	69,690	842,000	1,697,000
Utah	52,700	....	52,700	743,000	1,318,000
Idaho	52,100	....	52,100	1,162,000	2,567,000
Wyoming	....	....	....	773,000	1,305,000
New Mexico	....	....	....	160,000	439,000
Arizona	16,200	....	16,200	893,000	1,698,000
Nevada	14,200	....	14,200	172,000	276,000
California	429,467	6,000	435,467	3,424,000	7,818,000
Washington	300,510	....	300,510	4,932,000	8,647,000
Oregon	95,777	....	95,777	3,148,000	6,613,000

developed manufacturing power in the country, and this is largely used in the manufacture of pulp and paper. In the Southern states, South Carolina leads with nearly 5 per cent of the total developed manufacturing power in the country, nearly all of which is used in the cotton-manufacturing industry.

The concerns whose ownership is summarized in this table have developed only about three-fifths of the power they own. By far the largest amount of undeveloped power owned by such concerns is found in California, where it amounts to 732,749 h.p. Next is Georgia with 286,350 h.p., then New York with 193,093 h.p., then Iowa with 151,000 h.p., Oregon with 143,600 h.p., Michigan with 117,650 h.p., Washington with 115,700 h.p., Montana with 105,700 h.p., Minnesota with 101,600 h.p., and Maine with 100,000 h.p. These figures for undeveloped power are undoubtedly conservative.

A notable fact disclosed by the table is the remarkable natural centralization of water-power in the United States. Approximately 11,500,000 h.p. (on the 75 per cent efficiency basis), or 43 per cent of the total estimated minimum power of the country is found in the States of California, Oregon, and Washington alone. If we add to this total the power in the three states of Montana, Idaho, and Wyoming, we have in the six states 60 per cent of the total power, and by including the three states of Colorado, Arizona, and Utah, we find in the nine states mentioned 70 per cent of the estimated minimum power in the United States. About 8 per cent of the minimum total is found in the territory in the northeastern section of the country, including Pennsylvania and the states to the north and east. In the area east of the Mississippi River and South of the Ohio River there is about 12 per cent. These three groups of states contain about 90 per cent of the estimated minimum water-power of the country, and more than one-third of the remainder is in the four states of Michigan, Wisconsin, Minnesota, and Illinois, bordering on the Great Lakes.

Thus, the great bulk of the water-power of the country is situated on what might be termed its edges. The great central basin of the United States has an insignificant percentage. In fact there is but one great water-power in all this region, namely, that on the Mississippi River at Keokuk, Iowa.

5. MINERAL PRODUCTION IN THE UNITED STATES BY STATES[1]

TABLE XXVIII

State	Principal Mineral Products in 1915 (in Order of Value)*	Value of All Minerals (000 omitted)	Percentage of Total for United States	Value of Leading Mineral (000 omitted)
Pennsylvania	Coal, clay products, natural gas, cement	$460,080	22.0	$352,000
West Virginia	Coal, natural gas, petroleum, clay products	135,111	6.5	74,600
Illinois	Coal, petroleum, clay products, cement	114,704	5.5	64,600
Ohio	Clay products, coal, natural gas, petroleum	105,030	5.0	36,800
California	Petroleum, gold, copper, cement	97,172	4.6	36,600
Michigan	Copper, iron ore, cement, salt	93,938	4.5	46,400
Arizona	Copper, gold, silver, zinc	91,541	4.4	80,500
Montana	Copper, zinc, silver, gold	89,147	4.3	46,800
Oklahoma	Petroleum, natural gas, coal, zinc	81,311	3.9	56,700
Missouri	Zinc, lead, coal, clay products	74,489	3.6	33,800
Colorado	Gold, coal, zinc, silver	64,295	3.6	22,400
Utah	Copper, lead, silver, coal	62,586	3.0	32,800
Minnesota	Iron ore, clay products, stone, sand and gravel	62,391	3.0	57,700
Indiana	Coal, cement, clay products, stone	41,381	2.0	18,600
New Jersey	Zinc, clay products, stone, cement	38,818	1.8	†......
New York	Clay products, stone, cement, salt	36,385	1.7	9,500
Nevada	Copper, gold, silver, zinc	35,479	1.7	12,000
Idaho	Lead, zinc, silver, copper	33,612	1.6	16,300
Alaska	Gold, copper, silver, stone	32,853	1.6	16,700
Alabama	Coal, iron ore, clay products, cement	29,457	1.4	19,100
Kansas	Coal, natural gas, zinc, cement	29,346	1.4	11,400
Texas	Petroleum, coal, natural gas, cement	29,269	1.4	13,000
Kentucky	Coal, clay products, stone, natural gas	27,276	1.3	21,500
Iowa	Coal, clay products, cement, gypsum	27,048	1.3	13,600
New Mexico	Copper, coal, zinc, gold	25,549	1.2	13,400
Tennessee	Coal, zinc, copper, stone	22,166	1.1	6,500
Wisconsin	Zinc, stone, iron ore, zinc and lead pigment	19,778	.9	10,300
Louisiana	Petroleum, sulphur, natural gas, salt	18,199	.9	10,800
Virginia	Coal, stone, clay products, lime	16,991	.8	8,000
Wyoming	Coal, petroleum, iron ore, gypsum	12,708	.6	9,600
Washington	Coal, cement, stone, clay products	11,455	.5	5,300
Maryland	Coal, clay products, cement, stone	10,433	.5	5,300
South Dakota	Gold, stone, silver, sand and gravel	8,093	.4	7,400
Vermont	Stone, slate, talc and soapstone, lime	7,586	.4	5,600
Arkansas	Coal, bauxite, zinc, sand and gravel	6,558	.3	3,000

*In this table iron ore, not pig iron, is taken as the basis of iron valuation, and in the case of other metals mine production (recoverable content of metals) is the basis.

† Not published; probably about 18,000.

[1] Adapted from *Mineral Resources of the United States*, 1915, Part I, p. 59*a*.

TABLE XXVIII—*Continued*

State	Principal Mineral Products in 1915 (in Order of Value)*	Value of all Minerals (000 omitted)	Percentage of Total for United States	Value of Leading Mineral (000 omitted)
Massachusetts	Stone, clay products, lime, sand and gravel	$6,286	0.3	$3,300
Georgia	Clay products, stone, cement, coal	5,094	.2	1,800
Florida	Phosphate rock, fuller's earth, stone, clay products	4,886	.2	3,800
Oregon	Gold, stone, clay products, sand and gravel	3,656	.2	1,900
North Carolina	Stone, clay products, mica, gold	3,432	.2	1,400
Connecticut	Clay products, stone, lime, mineral waters	3,332	.2	1,500
Maine	Stone, lime, clay products, mineral waters	3,301	.1	1,100
New Hampshire	Stone, clay products, sand and gravel, mica	1,903	.1	1,200
Nebraska	Clay products, stone, sand and gravel, cement	1,514		800
South Carolina	Clay products, stone, phosphate rock, mineral waters	1,129		400
North Dakota	Coal, clay products, sand and gravel, mineral waters	985		800
Rhode Island	Stone, clay products, mineral waters, lime	855	.3	700
Mississippi	Clay products, sand and gravel, mineral waters	666		400
Delaware	Clay products, stone, mineral waters	282		100
District of Columbia	Clay products, sand-lime brick, sand and gravel	205		100
Grand total for United States		$2,393,831	......	......

As the value of a mineral second in rank in one state may be more than the value of the same mineral first in rank in another state, it must be realized that the figures in the fifth column of Table XXVIII cannot be used to ascertain the ranking of the states producing a particular mineral.

The material in Table XXVIII can be thrown into regional form by placing the percentages in the fourth column on an outline map of the United States. The regions may be emphasized by coloring differently (1) the leading state, (2) the states having 2 per cent or more, (3) the states having 1, but less than 2 per cent, and (4) the states having less than 1 per cent.

6. MANUFACTURING INDUSTRIES OF THE UNITED STATES

TABLE XXIX

Leading Manufacturing Industries of the United States by States for 1914. Industries with a Total Value of Products of Less Than $20,000,000 Are Not Listed.

(000,000 omitted in columns three and four)

State and Industry	Number of Establishments	Average Number of Wage Earners	Total Value of Products	Value Added by Manufacture	Percentage of Increase in Value of Products 1909–14
New York (all industries)	48,203	1,057,857	$3,814	$1,706	13.2
Clothing, women's	3,835	108,393	345	162	26.7
Printing and publishing	4,806	64,020	257	188	18.6
Clothing, men's, including shirts	2,627	81,370	239	121	−10.3
Foundry and machine-shop products	3,093	66,690	173	105	12.3
Slaughtering and meat packing	337	6,641	148	18	16.5
Sugar, refining	5	4,899	125	11	....
Bread and other bakery products	4,249	27,002	109	50	26.7
Tobacco manufactures	2,871	30,489	88	50	14.9
Liquors, malt	153	9,826	86	61	10.3
Hosiery and knit goods	483	40,095	78	34	16.5
Flour-mill and gristmill products	891	3,070	77	10	10.9
Electrical machinery, apparatus, and supplies	215	23,738	74	36	50.0
Millinery and lace goods	1,308	26,124	72	35	38.8
Boots and shoes	309	27,561	71	28	48.2
Lumber and timber products	1,776	21,503	60	27	−17.6
Paper and wood pulp	150	13,570	56	20	15.3
Gas, illuminating and heating	131	10,090	53	31	24.7
Furniture and refrigerators	758	22,153	50	28	18.9
Furnishing goods, men's	346	17,495	45	22	7.6
Copper, tin, and sheet-iron products	791	16,040	45	20	16.6
Butter, cheese, and condensed milk	1,144	3,235	43	6	1.9
Chemicals	70	7,780	43	17	21.3
Automobiles, including bodies and parts	247	12,122	42	20	35.9
Patent medicines and compounds and druggists' preparations	806	5,699	42	25	11.9
Leather, tanned, curried, and finished	98	5,360	36	8	30.3
Photographic apparatus and materials	59	7,420	35	25	87.5
Confectionery	349	10,768	34	14	33.4
Musical instruments, pianos and organs and materials	160	12,602	33	17	− 1.8
Food preparations, not elsewhere specified	287	4,031	32	12	85.7
Iron and steel, steel works and rolling mills	24	10,788	32	14	−18.9
Paint and varnish	150	3,450	32	13	11.6
Coffee and spice, roasting and grinding	136	1,690	32	6	81.7
Cars and general shop construction and repairs by steam-railroad companies	107	20,234	31	17	42.2
Fur goods	877	5,904	30	13	−26.6
Silk goods	143	11,659	29	13	10.3
Soap	65	3,168	28	8	16.7
Carpets and rugs, other than rag	14	12,540	26	10	1.8
Canning and preserving	987	8,757	26	10	36.3
Brass, bronze, and copper products	228	6,627	24	9	8.0
Jewelry	566	5,051	22	11	7.1
Leather goods	605	7,473	22	10	3.8
Boxes, fancy and paper	331	14,192	22	12	52.4
Woolen and worsted goods	51	8,552	21	8	−11.1

A minus sign (−) denotes decrease.

TABLE XXIX—*Continued*

State and Industry	Number of Establishments	Average Number of Wage Earners	Total Value of Products	Value Added by Manufacture	Percentage of Increase in Value of Products 1909–14
Pennsylvania (all industries)	27,521	924,478	$2,832	$1,143	7.8
Iron and steel, steel works and rolling mills	178	131,955	448	163	−10.4
Foundry and machine-shop products	1,887	91,820	234	125	10.9
Iron and steel, blast furnaces	52	11,518	136	20	−19.4
Cars and general shop construction and repairs by steam-railroad companies	163	54,729	94	44	23.1
Silk goods	284	44,755	87	38	40.1
Leather, tanned, curried, and finished	120	11,988	85	17	9.4
Printing and publishing	2,538	26,909	85	57	20.4
Slaughtering and meat packing	166	3,687	66	8	27.3
Woolen and worsted goods	203	24,461	64	20	−16.8
Hosiery and knit goods	498	41,130	64	26	29.2
Tobacco manufactures	2,194	37,370	54	30	8.1
Bread and other bakery products	2,987	15,157	54	22	18.1
Petroleum, refining	48	4,902	53	8	− 0.4
Liquors, malt	215	7,512	50	35	5.6
Lumber and timber products	2,348	21,297	50	26	−13.1
Sugar, refining, not including beet sugar	3	1,741	46		....
Electrical machinery, apparatus, and supplies	105	14,866	44	27	41.6
Flour-mill and gristmill products	1,265	2,595	44	7	− 2.6
Coke, not including gashouse coke	108	9,871	43	13	−17.0
Clothing, men's, including shirts	699	21,126	40	20	1.7
Glass	103	23,606	40	24	21.3
Cars, steam-railroad, not including operations of railroad companies	12	9,955	40	10	44.8
Clothing, women's	483	17,217	37	17	12.9
Tin plate and terneplate	13	2,368	37	5	45.8
Cotton goods	155	14,640	32	15	− 4.5
Cement	26	7,910	29	13	54.2
Boots and shoes	146	13,414	29	12	43.4
Paper and wood pulp	53	7,447	25	9	28.0
Furniture and refrigerators	324	12,088	25	13	32.7
Brick, tile, pottery, and other clay products	377	18,976	24	16	9.7
Carpets and rugs, other than rag	63	9,569	23	9	− 7.2
Chemicals	39	4,748	22	10	40.1
Massachusetts (all industries)	12,013	606,698	1,641	710	10.1
Boots and shoes	884	85,114	255	91	8.0
Cotton goods	189	113,559	197	77	5.8
Woolen and worsted goods	171	54,255	130	47	− 8.2
Foundry and machine-shop products	932	41,361	86	55	− 1.5
Printing and publishing	1,344	18,170	56	39	18.4
Slaughtering and meat packing	107	3,582	54	7	22.6
Leather, tanned, curried, and finished	126	10,164	45	12	13.2
Electrical machinery, apparatus, and supplies	91	17,125	44	26	55.9
Paper and wood pulp	86	13,401	43	17	8.1
Bread and other bakery products	1,419	8,083	33	15	27.4
Boots and shoes, rubber	9	8,087	24	13	27.1
Cordage and twine and jute and linen goods	20	7,614	23	6	45.7
Lumber and timber products	589	8,156	23	10	0.1
Rubber goods, not elsewhere specified	42	4,743	23	9	45.7
Dyeing and finishing textiles	57	11,437	22	11	2.6
Confectionery	148	6,787	20	8	31.9
Clothing, men's, including shirts	227	7,645	20	9	7.1

A minus sign (−) denotes decrease.

TABLE XXIX—*Continued*

State and Industry	Number of Establishments	Average Number of Wage Earners	Total Value of Products	Value Added by Manufacture	Percentage of Increase in Value of Products 1909–14
New Jersey (all industries)	9,742	373,605	$1,407	$523	22.8
Smelting and refining, copper	4	3,344	159	5	26.7
Petroleum, refining	8	5,178	91	11	....
Silk goods	368	28,263	76	35	15.7
Foundry and machine-shop products	908	31,057	74	42	13.3
Electrical machinery, apparatus, and supplies	76	14,405	41	20	43.6
Slaughtering and meat packing	90	2,197	40	4	6.7
Tobacco manufactures	394	15,830	40	22	64.2
Woolen and worsted goods	32	14,464	36	13	6.9
Chemicals	64	6,276	23	15	38.8
Leather, tanned, curried, and finished	84	5,108	32	10	11.3
Dyeing and finishing textiles	98	11,683	28	14	77.2
Rubber goods, not elsewhere specified	53	6,316	25	10	30.3
Bread and other bakery products	1,278	5.712	22	9	11.1
Liquors, malt	29	2,588	20	15	1.5
Cotton goods	30	7,394	17	7	22.2
Brick, tile pottery, and otherclay products	140	13,011	17	12	− 3.0
Connecticut (all industries)	4,104	226,264	545	257	11.3
Brass, bronze, and copper products	67	16,781	69	15	3.6
Foundry and machine-shop products	388	39,369	67	42	2.2
Cotton goods	50	15,466	31	13	27.1
Silk goods	44	10,668	31	12	45.2
Firearms and ammunition	13	10,863	26	14	28.6
Rhode Island (all industries)	2,190	113,425	280	117	− 0.3
Woolen and worsted goods	80	22,745	61	19	−18.4
Cotton goods	102	29,483	50	21	− 1.2
Jewelry	291	8,778	22	10	4.0
Maine (all industries)	3,373	82,149	200	83	13.9
Paper and wood pulp	38	10,033	40	15	18.4
Lumber and timber products	952	15,452	28	14	5.6
Boots and shoes	59	8,986	23	8	50.4
Cotton goods	20	21,669	36	13	18.4
New Hampshire (all industries)	1,736	78,993	183	68	11.1
Boots and shoes	71	14,815	47	13	18.4
Cotton goods	20	21,669	36	13	6.5
Vermont (all industries)	1,772	32,704	77	34	12.7
Delaware (all industries)	808	22,155	56	24	6.0
Maryland (all industries)	4,797	111,585	378	139	19.7
Clothing, men's, including shirts	301	18,062	39	18	5.8
Copper, tin, and sheet-iron products	114	7,712	25	9	50.8
Virginia (all industries)	5,508	102,820	264	109	20.2
Lumber and timber products	2,218	26,307	32	19	− 9.5
Tobacco manufactures	76	6,308	30	18	18.6
Kentucky (all industries)	4,184	64,586	230	115	2.9
Liquors, distilled	157	2,098	49	39	10.1
Flour-mill and gristmill products	442	1,447	21	4	− 5.1
Lumber and timber products	1,299	13,337	21	10	− 3.3

TABLE XXIX—*Continued*

State and Industry	Number of Establish-ments	Average Number of Wage Earners	Total Value of Products	Value Added by Manu-facture	Per-centage of Increase in Value of Products 1909–14
Tennessee (all industries)	4,775	74,373	$212	$89	17.6
Lumber and timber products	1,972	18,276	31	17	3.2
Flour-mill and gristmill products	512	1,497	26	4	9.1
West Virginia (all industries)	2,749	71,078	194	83	19.5
Lumber and timber products	995	17,417	29	19	0.8
Iron and steel, steel works, and rolling mills	15	5,348	21	7	− 5.6
North Carolina (all industries)	5,507	136,844	289	119	33.6
Cotton goods	293	53,703	91	28	24.8
Tobacco manufactures	33	10,467	58	34	60.8
Lumber and timber products	2,952	34,374	40	23	18.2
Georgia (all industries)	4,639	104,461	253	93	24.8
Cotton goods	118	30,719	60	19	24.9
Oil, cottonseed, and cake	153	4,212	33	5	38.4
Fertilizers	230	3,833	29	8	72.9
Lumber and timber products	1,588	18,196	22	13	−10.2
Alabama (all industries)	3,242	78,717	179	71	22.5
Cotton goods	57	13,697	26	8	15.4
Lumber and timber products	1,421	22,750	24	15	6.7
Iron and steel, blast furnaces	15	3,547	20	6	− 5.5
South Carolina (all industries)	1,885	71,914	139	48	22.7
Cotton goods	148	46,448	78	25	19.0
Florida (all industries)	2,518	55,608	81	47	11.3
Lumber and timber products	507	18,358	21	14	2.8
Louisiana (all industries)	2,211	77,665	255	97	14.0
Lumber and timber products	516	44,419	67	39	6.1
Sugar refining, not including beet sugar	171	4,798	58	9	− 9.1
Arkansas (all industries)	2,604	41,979	84	39	12
Lumber and timber products	1,252	29,698	43	25	6.1
Mississippi (all industries)	2,209	46,702	80	38	− 1.2
Lumber and timber products	1,296	29,640	39	24	− 9.9
Texas (all industries)	5,084	74,853	361	108	32.4
Slaughtering and meat packing	21	3,491	53	9	24.6
Oil, cottonseed, and cake	233	4,471	42	6	40.2
Flour-mill and gristmill products	191	1,300	35	6	8.1
Lumber and timber products	587	19,956	29	17	−10.7
Oklahoma (all industries)	2,518	17,443	102	31	90.0
Illinois (all industries)	18,388	506,943	2,247	907	17.1
Slaughtering and meat packing	98	31,627	489	77	25.6
Foundry and machine-shop products	1,371	55,261	141	81	2.0
Printing and publishing	2,722	32,838	113	80	29.3
Clothing, men's, including shirts	604	35,119	89	48	− 0.4
Agricultural implements	73	19,556	65	32	14.1
Iron and steel, steel works and rolling mills	25	15,408	65	25	−25.0
Cars, steam-railroad, not including operations of railroad companies	23	18,000	61	21	127.1
Liquors, distilled	7	855	52	43	− 6.5
Flour-mill and gristmill products	406	2,398	49	7	− 3.2
Electrical machinery, apparatus, and supplies	142	16,483	46	26	70.2

A minus sign (−) denotes decrease.

TABLE XXIX—*Continued*

State and Industry	Number of Establishments	Average Number of Wage Earners	Total Value of Products	Value Added by Manufacture	Percentage of Increase in Value of Products 1909–14
Illinois—*Continued*					
Bread and other bakery products....	2,278	10,404	$ 45	$ 22	25.3
Lumber and timber products........	618	14,870	42	18	− 6.4
Cars and general shop construction and repairs by steam-railroad companies	94	28,682	41	23	28.8
Liquors, malt....................	89	5,749	39	29	38.6
Furniture and refrigerators..........	283	13,766	33	17	18.3
Gas, illuminating, and heating.......	75	3,890	28	20	33.8
Tobacco manufactures..............	1,622	7,653	26	16	19.1
Iron and steel, blast furnaces........	5	1,450	26	4	−32.5
Copper, tin, and sheet-iron products..	508	7,445	25	11	8.7
Paints and varnishes................	72	2,110	24	9	19.8
Confectionery.....................	147	5,009	22	10	73.0
Coffee and spice, roasting and grinding	34	1,193	22	5	11.6
Butter, cheese, and condensed milk...	267	1,755	22	4	22.4
Soap..............................	27	2,144	21	6	6.1
Clothing, women's.................	241	8,113	21	10	24.7
Ohio (all industries).................	15,658	510,435	1,783	762	24.0
Iron and steel, steel works and rolling mills..........................	70	46,397	205	65	3.7
Foundry and machine-shop products..	1,379	73,103	179	101	22.6
Rubber goods, not elsewhere specified.	54	21,705	110	51	103.4
Automobiles, including bodies and parts..........................	102	18,752	86	30	120.7
Iron and steel, blast furnaces........	33	5,786	73	12	−12.8
Slaughtering and meat packing......	169	3,619	67	7	31.2
Printing and publishing.............	1,783	18,070	56	39	33.5
Flour-mill and gristmill products.....	649	2,363	45	6	− 6.1
Brick, tile, pottery, and other clay products.......................	549	27,334	39	26	26.6
Electrical machinery, apparatus, and supplies........................	119	12,695	36	19	92.4
Boots and shoes....................	73	14,674	34	14	6.6
Cars and general shop construction and repairs by steam-railroad companies	88	21,639	33	17	16.0
Bread and other bakery products....	1,634	7,665	31	13	32.8
Liquors, malt......................	101	5,340	32	23	26.3
Lumber and timber products........	1,188	11,921	32	14	− 7.9
Tobacco manufactures..............	961	13,282	28	17	− 1.5
Clothing, men's, including shirts.....	257	10,758	28	14	11.1
Food preparations, not elsewhere specified............................	76	1,523	27	7	152.3
Copper, tin, and sheet-iron products..	288	7,448	25	11	31.3
Paper and wood pulp...............	48	5,430	23	7	37.2
Clothing, women's.................	170	9,775	23	11	17.4
Stoves and furnaces, including gas and oil stoves.......................	105	8,575	20	12	30.1
Michigan (all industries)..............	8,724	271,090	1,086	493	58.5
Automobiles, including bodies and parts..........................	205	67,538	398	179	312.1
Foundry and machine-shop products..	705	26,497	65	37	42.2
Lumber and timber products........	748	28,527	59	29	− 4.9
Furniture and refrigerators..........	202	16,267	34	19	18.2
Flour-mill and gristmill products.....	427	1,370	27	4	−21.5
Leather, tanned, curried, and finished.	23	2,773	26	5	66.4
Printing and publishing.............	1,113	8,166	25	17	43.8
Paper and wood pulp...............	37	6,051	22	8	58.4
Butter, cheese, and condensed milk...	364	1,367	22	3	50.8
Slaughtering and meat packing......	36	1,181	21	2	58.3
Tobacco manufactures..............	626	9,075	21	12	27.7

TABLE XXIX—*Continued*

State and Industry	Number of Establishments	Average Number of Wage Earners	Total Value of Products	Value Added by Manufacture	Percentage of Increase in Value of Products 1909–14
Indiana (all industries)	8,022	197,503	$730	$307	26.2
Iron and steel, steel works and rolling mills	19	11,106	59	22	52.3
Slaughtering and meat packing	68	4,484	51	5	8.0
Foundry and machine-shop products	513	17,025	49	28	22.6
Flour-mill and gristmill products	512	2,281	37	5	− 7.5
Liquors, distilled	14	508	31	26	− 0.4
Automobiles, including bodies and parts	86	7,219	29	11	23.7
Cars, steam-railroad, not including operations of railroad companies	10	5,800	22	8	127.1
Carriages and wagons and materials	193	7,306	22	11	− 0.4
Furniture	197	10,803	21	11	....
Lumber and timber products	913	7,641	21	9	− 9.1
Cars and general shop construction and repairs by steam-railroad companies	49	14,398	21	11	20.2
Wisconsin (all industries)	9,104	194,310	695	278	17.8
Butter, cheese, and condensed milk	2,431	3,717	73	8	35.3
Foundry and machine-shop products	494	26,521	61	33	12.1
Lumber and timber products	635	32,282	55	30	− 4.5
Leather, tanned, curried, and finished	27	5,869	42	9	− 5.5
Liquors, malt	132	5,414	41	27	27.3
Slaughtering and meat packing	46	2,236	35	4	27.5
Paper and wood pulp	58	8,968	31	11	20.2
Flour-mill and gristmill products	252	1,116	29	4	− 9.4
Furniture and refrigerators	114	11,792	23	12	21.1
Agricultural implements	46	3,143	20	11	76.3
Missouri (all industries)	8,386	152,182	638	249	11.1
Slaughtering and meat packing	40	5,200	92	7	15.7
Boots and shoes	54	14,740	53	15	7.7
Flour-mill and gristmill products	641	2,096	39	5	13.1
Tobacco manufactures	431	3,997	33	19	7.9
Printing and publishing	1,333	10,571	33	24	11.9
Liquors, malt	32	5,947	32	24	15.9
Foundry and machine-shop products	356	8,449	22	12	11.5
Bread and other bakery products	1,043	5,269	20	10	7.6
Minnesota (all industries)	5,974	92,834	493	157	20.5
Flour-mill and gristmill products	286	4,564	148	21	6.5
Slaughtering and meat packing	29	2,587	48	6	85.3
Lumber and timber products	453	20,947	45	22	5.5
Butter, cheese, and condensed milk	807	1,458	34	3	33.5
Foundry and machine-shop products	409	7,051	21	11	37.1
Printing and publishing	994	6,134	20	15	26.3
Kansas (all industries)	3,136	41,259	323	62	− 0.6
Slaughtering and meat packing	26	9,884	152	16	− 8.3
Flour-mill and gristmill products	360	2,357	73	9	6.5
Iowa (all industries)	5,614	63,113	311	105	19.9
Slaughtering and meat packing	33	4,430	74	6	25.8
Butter, cheese, and condensed milk	490	1,333	28	4	6.8
Nebraska (all industries)	2,492	25,144	222	48	11.4
Slaughtering and meat packing	10	5,713	105	10	13.2
North Dakota (all industries)	699	3,275	21	7	10.5
South Dakota (all industries)	898	3,788	24	7	35.1

A minus sign (−) denotes decrease.

TABLE XXIX—*Continued*

State and Industry	Number of Establish-ments	Average Number of Wage Earners	Total Value of Products	Value Added by Manu-facture	Per-centage of Increase in Value of Products 1909–14
Colorado (all industries)	2,126	27,278	$137	$ 47	5.2
Montana (all industries)	939	13,704	84	38	15.3
Utah (all industries)	1,109	13,894	87	25	40.5
Smelting, lead	3	1,882	22	4	....
Arizona (all industries)	322	6,898	64	25	27.5
Smelting and refining, copper	9	2,906	53	19	30.1
Idaho (all industries)	698	8,919	28	14	27.0
Nevada (all industries)	180	3,655	16	7	35.3
New Mexico (all industries)	368	3,776	9	5	18.0
Wyoming (all industries)	337	2,989	11	6	79.6
California (all industries)	10,057	139,481	713	265	34.6
Canning and preserving	289	12,756	61	15	85.8
Petroleum refining	38	1,930	56	17	210.6
Lumber and timber products	632	22,438	53	27	17.5
Slaughtering and meat packing	108	2,220	50	9	45.9
Printing and publishing	1,543	8,759	35	25	38.9
Foundry and machine-shop products	1,097	9,747	32	17	18.7
Flour-mill and gristmill products	132	1,067	24	5	− 4.4
Bread and other bakery products	1,116	4,851	22	10	23.4
Butter, cheese, and condensed milk	201	1,044	20	2	60.4
Washington (all industries)	3,829	67,205	245	109	11.1
Lumber and timber products	939	38,079	84	45	− 6.3
Flour-mill and gristmill products	100	928	24	3	32.6
Oregon (all industries)	2,320	28,829	110	47	18.0
Lumber and timber products	526	13,888	31	17	2.4

CHAPTER IX

NORTHEASTERN UNITED STATES

1. TOPOGRAPHY AND UNDERLYING ROCK IN NEW ENGLAND[1]

Maine. The surface of Maine consists essentially of an extensive southward-facing slope draining directly into the Atlantic Ocean and a smaller northward-facing slope draining into St. John River. The latter area is a great plain covered largely by swamps and interrupted by a few irregular-shaped hills. The surface of the southern slope is much more broken. It is crossed by many ridges of low mountains trending east or northeast, some of which rise several thousand feet above the platform on which they rest. These are separated by wide areas of plâin, on which are many small glacial hills and ridges. Near the coast the surface is rough. Rocky ridges and low, bare hills stretch from the shore line some miles inland, but the hills are not lofty and the valleys between them are not deep. The northern portion of the state is underlain by moderately folded limestones, shales and sandstones, cut here and there by igneous rocks. The section bordering on the coast is underlain by granites, gneisses, and other crystalline rocks. The central portion of the state is composed of slates, quartzites, and limestones, very much like the rocks in the northern belt, but more crystalline and more closely folded. Upon the rocks of all three belts the ice sheet deposited clay, sand, gravel, and a mixture of clay and bowlders. It is from such glacial material that the soils of New England have been formed.

New Hampshire. Taken as a whole New Hampshire is more rugged than any other New England state. Although the White Mountains are lacking in the definite trend which characterizes the

[1] Adapted from M. L. Fuller, "Underground Waters of Eastern United States," *United States Geological Survey, Water-Supply and Irrigation Paper No. 114*, pp. 41, 42, 57, 58, 60, 68. Mr. Fuller is a member of the United States Geological Survey.

Green Mountain and Berkshire Hill ranges, they comprise, nevertheless, the highest and most rugged peaks of the eastern section of the country north of North Carolina. The highest land is the western and northern parts of the state, culminating in the White Mountains of the north-central portion, where Mount Washington and several other peaks reach elevations of 5,000 to 6,000 feet or over. The lowest area within the state is in the southeastern portion, where much of the land is less than 500 feet above sea-level, considerable tracts lie between 500 and 1,000 feet and a few hills and ridges above 1,000 feet. In most instances the hills and mountains present smooth and rounded-out lines while most of the valleys are wide with gentle or moderate slopes.

Like other New England states, New Hampshire is covered with surface deposits of unconsolidated material laid down by the ice sheet or its associated drainage ways. This surface material or drift is not of uniform distribution, being in general of much greater thickness in the southern portion of the state than in the northern. Neither is the drift of uniform thickness in the same general region, the crests and sides of the mountains and many of the higher hills being thinly coated with or even nearly free from glacial materials. In the valleys and on the lowlands, however, the drift deposits reach a considerable thickness and afford the most important source of water in the state.

Vermont. The Green Mountain Range which divides Vermont into nearly equal east and west portions, forms a watershed from which most of the streams flow either east into the Connecticut or west into Lake Champlain. As the mountains and foothills occupy a large portion of the state there is little level ground, the surface being mostly uneven—mountain, hill, or valley. The whole state is covered with glacial deposits. The largest area of land level enough to farm is in the Champlain lowland which is a prosperous farming district.

Southern New England. In a broad way southern New England may be subdivided according to the relief of the land, into a number of belts, each marked by its own characteristic geology and topography. The westernmost of these may be termed the Berkshire Hills. These are a series of mountainous ridges lying in the extreme western part of the area, the rocks of which consist of strongly

folded and faulted quartzites, limestones, slates, schists, etc., which by resisting erosion have given rise to rugged topography. To the east, the Berkshire Hills grade into a less rugged and somewhat lower region of similar rocks and structure, which extends to the lowlands bordering the Connecticut Valley. These lowlands are underlain by soft reddish sandstones and shales. East of the Connecticut Valley is a dissected crystalline upland which in some places extends to the coast. In the vicinity of Boston and of Narragansett Bay there are somewhat level areas underlain with sandstones, conglomerates, and slates. Cape Cod and a portion of the adjacent region consist, superficially, entirely of gravel and sands of glacial origin. The Boston Basin, the Narragansett lowlands, and the lower Connecticut Valley are the more important parts of southern New England.

2. FARM PROBLEMS IN NORTHEASTERN UNITED STATES[1]

a) New England is pre-eminently a section of small farms, due largely to the generally broken character of the country, the farming land being located in small areas scattered among the hills. Since the farms are small, some type of intensive farming must be followed to make them profitable. Since the land has already been tilled longer than good land will bear an exploitive system of farming, some type of live stock farming is a necessity on most farms. As the most intensive form of stock farming is dairying, this latter industry is naturally the leading one on New England farms. Dairying, in the main, has been a profitable business in New England, but in recent years conditions have changed, and the outlook is not so satisfactory as it has been at various times in the past.

Some of the difficulties which are at present most evident are the high prices of concentrated feeds and of labor. Some sections of New England, furthermore, feel the pressure of unsatisfactory market conditions, especially those sections which ship milk to the large cities, where the farmers are offered a price for their milk on which they can hardly make a profit.

[1] Adapted from United States Department of Agriculture, *Farmer's Bulletin, No. 337*, pp. 7–8, and *Bureau of Plant Industry, Circular No. 49*, pp. 3–4, 10; Vermont Department of Agriculture, *Bulletins No. 17* and *No. 22*, pp. 5–8; Maine Department of Agriculture, *Agricultural Opportunities in Maine*, 1917, p. 5.

Outside of the milk-shipping sections the difficulties mentioned do not appear, on careful observation, to be the most fundamental, though they are the most obvious. Taking the northeastern states of the Union as a whole, owing to climate and topography the land is in general adapted to the growth of grass and trees. The fact that grass is so much at home in those states has led to a serious fault in New England dairy farming, namely, the mismanagement of grass lands. This consists in the main of a lack of proper treatment for permanent grass lands and of suitable rotations for other land, as well as the use for grass growing of land which does not give profitable returns from grass and which should rightfully be devoted to tree growth, either as woodland or orchards. Another frequent and widespread fault is the habit of cutting the hay crop entirely too late in the season, which of itself shortens the life of the meadow and results in an inferior quality of hay for dairy feeding.

Closely associated with poor management of grass lands is the failure to utilize other crops available for this section, especially corn. In southern New England there is little difficulty in growing good silage corn, but as one travels northward there is evidence of a lack of suitable varieties of corn for silage. This difficulty is not insuperable. There are varieties of corn that can be grown for silage in all but the most northern counties in New England. What is most needed is that sufficient attention be given to the selection of seed in order to develop strains of corn fitted to the requirements of the different sections.

b) One of the most important problems confronting farmers in the eastern states is the improvement of worn-out pastures. This is especially true in eastern New York and the New England states which primarily are regions of live stock farming, for the most part dairying. The problem of the old pastures is closely associated with the general problem of producing feed for dairy cows on the farms of those states. The pastures in this region are of two general types: (1) those that are smooth enough to permit cultivation and which, if so desired, can be included in a rotation system; and (2) those that are too rough and too rocky to permit cultivation and can only be utilized as pastures or allowed to grow up to timber. Figures have not been obtained to show the relative percentage of these two types of pastures. In eastern New York it is probable that the area

of each kind is about the same. In the New England states the country is more broken, and the rough, broken pasture land that must always remain as such greatly predominates.

These pastures were cleared of timber from forty to one hundred years ago, depending somewhat on the locality in which they are situated. For the most part they were allowed to sod over by natural processes. So far as can be learned, they have been grazed continuously from early spring until late fall, practically to their full grazing capacity, ever since their establishment. During this time almost no improvement in the way of fertilizing, seeding, or keeping the weeds down has been attempted. As a result many of these pastures have been so badly overgrazed that at the present time they do not produce enough feed to pay for maintaining the fences, let alone the building of new ones. In many cases weeds have taken complete possession. In a number of instances the pastures have been entirely abandoned and are growing up to young timber. Close grazing leads to the deterioration of pastures because (1) it prevents perennial plants storing the food necessary for starting in spring; (2) it results in a heavy loss of humus; (3) it makes the ground too dry for the maintenance of native forage plants; and (4) it causes a considerable loss of plant food from the soil.

It is stated that this depreciation has been very rapid during the last twenty years. There are two reasons for this: First, the depreciation of a pasture as the result of overgrazing will be much greater during the latter half or even quarter of the period grazed than in the preceding years. Again, with the increased demand for dairy products and with better facilities for transportation there has been a decided tendency on the part of the farmers to buy western grain and raise only the necessary roughage on their places. This has enabled them to carry much more stock. With this increase in stock there has not been any corresponding increase in the size of the pastures, nor has there been any attempt to increase their carrying capacity. These conditions can be remedied by (1) the prevention of overgrazing; (2) the prevention of too early grazing; (3) fertilizing; (4) cultivating; (5) reseeding; and (6) the eradication of weeds.

c) It has been apparent for some time that the production and distribution of milk in the New England states is not on a sound

economic basis, and that there is something radically wrong with the way in which this important industry is now being conducted. It is obvious that the opportunities in the industry are far from being fully realized (1915). The large cities of southern New England would naturally look to the adjoining territory for their supply. This territory (northern and central New England) is well able to support a flourishing dairy industry—and dairying should naturally be the largest single branch of New England agriculture, our greatest single industry.

Generally speaking the per capita consumption of milk in the United States has been steadily increasing; but in certain districts of New England the per capita consumption has been decreasing for the past ten years, and the amount required has been drawn from a larger and larger territory, and from districts more and more remote.

In short, despite the increase in our urban population, the output of the principal agricultural industry in the immediate adjoining territory has declined Country districts, which ought to be flourishing, are at a standstill.

Fifteen years ago, Maine had 72 creameries, New Hampshire 24, Vermont 240 (including about 30 cheese factories), Massachusetts 20, and Connecticut 19, which sent their entire product to market as butter or cheese. Boston received its milk supply from a radius of 125 to 150 miles, and the other large cities in New England from their immediate vicinity. The sale of cream was only beginning; previous to this period it was a very small factor in the milk industry.

Today (1915), 55 of the 72 creameries in Maine are owned by 4 companies which ship the greater part of their product as whole milk, cream, and skim milk, making butter in the surplus season of the year only. In New Hampshire and Vermont, from 60 to 75 per cent of the creameries are owned by 8 or 10 dealers who are shipping the greater part of their product as whole milk, cream, and skim milk, and are making butter of the surplus.

In Massachusetts and Connecticut there are about 30 creameries which are selling, for the most part, cream and butter, their output being small in comparison with the big dairy sections of New Hampshire, Vermont, Maine, and Quebec.

Since 1910 there has been a remarkable increase in the sale of cream not only for ice-cream but for general family use, in cooking,

in serving fancy dishes in the hotels and restaurants, and in candy manufacturing, until now the price paid for cream establishes largely the basis for the price paid for milk.

Metropolitan Boston receives about 20 per cent of its milk supply locally, and 80 per cent from Maine, New Hampshire, Vermont, eastern New York, and Connecticut. It receives its cream supply from Maine, New Hampshire, Vermont, Quebec, and New York.

Previous to 1910 there was a duty on milk, cream, and butter coming in from Canada. At present there is a duty on butter only. Milk and cream come in duty free.

d) Since Vermont is located but a short distance from the large market centers of New England and New York, it would seem that the marketing problem for our producers should be a comparatively simple one, but a visit to one of these markets will convince a student of the problem that skill in preparation for market and in transportation has overcome the handicap of distance for more remote sections. It is no uncommon thing to see in any of our large markets fruits, vegetables, poultry products, etc., shipped for a distance of over a thousand miles selling for much better prices than similar products shipped from a distance of one to three hundred miles. The reason is that shippers from a distance, because of high transportation charges, have been forced to bring their produce up to a high standard. The citrus fruit growers of California and the apple growers of Washington and Oregon, through co-operative associations, have been able to standardize their products to such a degree that a commission firm in Boston or New York feels safe to order a carload of a particular brand, guaranteed by one of these associations, knowing that the fruit sent will be up to the standard of the brand ordered. Since dealers prefer to deal in a wholesale way in standardized goods rather than in small lots of unstandardized goods, the best trade is naturally going to those progressive sections which have learned to co-operate for the improvement of their products. This is a lesson we must learn in Vermont if we expect to make the most of our agricultural opportunities. There is an almost unlimited market for Vermont butter, cheese, eggs, poultry, maple sugar, fruit, and vegetables, but these things must be produced so that they will be of the finest quality and packed and transported to market so they will arrive in the finest possible condition.

e) Of the total land area of Maine, only 9,839 square miles are devoted to farming and but a little more than a third of this, or 3,688 square miles, are classed as "improved land in farms." In other words, though the most remote point in Maine is less than 250 miles from the populous, non-food-producing Massachusetts, Connecticut, Rhode Island, and New York markets, yet only about a third of the land area is devoted to farms and only a third of the farm land is cultivated. Some of the balance is not suitable for farming—a great deal of it is held out of the market because of its timber resources—but there are still thousands of acres of practically virgin soil that are not utilized.

3. THE RELATION OF ENVIRONMENT TO THE TEXTILE AND PAPER INDUSTRIES IN MASSACHUSETTS[1]

The most marked attribute of Massachusetts' chief industry—manufacturing—is the degree to which various types are segregated or "localized"—to use the economic term. The textile industry, which is the greatest one in the state and in whose parts Massachusetts leads the nation, shows a marked tendency to cling to a few places. The cotton mills are for the most part in four localities, namely: on the southeast bays, the Merrimac and Connecticut rivers, and the Blackstone; the wool mills are gathered together on the small streams of the eastern highland; the shoe factories cling to the Boston lowland and eastern plateau; and the writing-paper plants are concentrated in the Connecticut Valley. A similar confinement to a narrow region is true of the jewelry, whip, horn-goods, chair, tanning and optical industries. We cannot attribute this high degree of localization to physical causes entirely, for that is by no means true, yet the isolation caused by the trend of the valleys has been a very large factor contributing to the result. Most industries spread from one center by imitation, so it is quite natural that the communities within easy reach from the originating town should be the ones most likely to copy a successful enterprise, for the towns in the next valley, though near at hand geographically, are far away socially

[1] Adapted from Malcolm Keir, "Some Responses to Environment in Massachusetts," *Bulletin of the Geographical Society of Philadelphia*, July and October, 1917, pp. 121–38, 167–85. Mr. Keir is professor of economics at Dartmouth College.

and industrially because the lines of communication are opposed to free interchange. We find, therefore, that the same industry is repeated in nearly every town in the same valley, even when that valley crosses two states, whereas the next valley, to the east or west, will be occupied by a different set of factories. As examples, the Quinnebaug and Thames valleys are full of woolen mills from Southbridge, Massachusetts, to Norwich, Connecticut, but, on the other hand, the next large valley to the west, the Connecticut, is just as characteristically a paper center. To clinch the matter yet closer, we have but to point to the fact that the capitalists who founded Lowell created Lawrence also, both towns in the same Merrimac River Valley, but it was Hartford money that built Holyoke, although Lawrence and Holyoke were started about the same time and for the same manufacturing industry, namely, cotton. As a consequence, the localization of industry is more characteristic of Massachusetts than any other state, a condition which is not due to economic causes entirely, but is partly based on the separation of each little section of Massachusetts from all the other parts of the state.

A no less important phase of the natural surroundings in Massachusetts is the effect produced upon the lives and occupations of the people by the one-time visitation of the glacier, the most important and far-reaching event in the geological history of the state. By forming numerous water-power sites, made excellent by reservoir lakes, the glacier was directly responsible for the later growth of manufacturing in Massachusetts; by distorting the soil, the ice sheet set in motion those forces which have made agriculture in the state of so little importance; and by removing the overburden of rock the passage of the northern invader brought to light the underlying stores of granite, the chief rock resource of the present commonwealth; therefore, manufacturing, agriculture, and quarrying, the three great industries of the present, have grown out of conditions produced in this one geological era of the past.

Wherever the ancient rivers were obstructed by glacial material, they were forced to find new paths around the blocked passageway and in making the detour often flowed over uncut ledges; the power at falls thus created has been a source of wealth that is difficult to estimate because the hundreds of small places made available for

manufacturing proved a boon to the earliest experimenters in factory enterprises and helped to establish manufacturing as the foremost industry of Massachusetts. All of the brooks and small streams of the state are full of falls and reach the large rivers through narrow canyons, both of which conditions favored their early development, for the reason that small streams were easier to control than large rivers and the canyons readily accommodated themselves to dams and reservoirs.

Waterfalls are useless for power purposes unless the stream flow is maintained with a high degree of uniformity throughout the year and here again the glacier aided the future commonwealth, for not only did the ice sheet produce falls but also made natural reservoirs wherein flood waters were stored and streams regulated during the dry season. After the main body of ice left the land, there remained in hollows and deep valleys blocks of ice which, slowly rotting, left depressions that formed lakes. In the course of time some of these lakes have been partially filled by vegetation and are now swamps. Both the lakes and swamps perform the same function of accommodating floods and holding back the water so as to bring about a more uniform flow in the stream. It is the *combination* of falls, and regularity in the volume of water, that makes a site valuable for power, and since the glacier endowed Massachusetts with both of these advantages, it enabled her to lead the way in the development of manufactures.

Naturally the most falls were in the highlands and mountains of Massachusetts and when about 1750 water-power commenced to be utilized for small mills, a deflection of population from the coastal plain and plateau took place, so that almost all of the present towns of importance in the inland territory began their history between 1750 and 1825. For the first time the domain remote from salt water assumed an importance in the eyes of the progressive young men in Massachusetts; a new resource was spread before their gaze. Mill after mill was set up, and towns consequently appeared where previously lonely farmers had led sequestered lives. The "Father of the Cotton Industry," Samuel Slater, whose first factory was at Pawtucket, Rhode Island (1790), followed the Blackstone River back into Massachusetts and established a new project in that part of Oxford that is now Webster. The whole Blackstone Valley from

Worcester to Providence became virtually one continuous mill village, and similarly the Quinnebaug River, from its diminutive sources above Southbridge southward to Norwich, Connecticut, clattered with the activity of wool mills. The Chicopee, the Westfield, and especially the small branches of all the streams named, took on an importance that hitherto had been utterly foreign to them. In this manner and for the purpose of developing the water resources, inland Massachusetts was settled and transformed to a region of potential consequence. To the citizen of 1812 who saw commerce paralyzed, and the promise of a rapid rise in the importance of manufacturing, it must have seemed that the long-neglected interior of the state would soon threaten the sovereignty of the shore zone, for the man of that time could not have foretold the limitations that progress in machines would place upon the water-power of the state; he could not have predicted that looms and spinning frames would grow so large and heavy that the power of many of the small streams would be inadequate. The era of water-power helped to distribute the population over a wider area and bring into usefulness a great proportion of the territory of the state, and in its heyday the textile industry became largely fixed as an inland business. If the invention of textile machinery had come *after* the successful application of steam engines to factory needs instead of *before* it, central Massachusetts would never have been much more than a summer resort. How true this statement is may be gauged by the shoe industry in which the industrial revolution did not take place until after 1850, with the result that it has always hugged the shore. If this business had been put upon a machine basis at the time when cotton was wrested from hand labor, it inevitably would have been moved inland[1] upon power sites, and the momentum of an early start would have kept it there. Fall River and New Bedford, located upon the coast and using coal for power, illustrate what would have happened to the majority of cotton mills if they had succeeded rather than preceded the steam engine. We must attribute the expansion of inland Massachusetts to its resource of glacially derived water-power and consider it fortu-

[1] There is a tendency on foot at present for shoe factories to move inland to textile centers, but this is due to the exactions of labor upon the coast and the effort of manufacturers to escape to a town where their shops will be the most prized work places because their wages are higher than in a cotton or woolen mill.

nate that its factories became firmly rooted before coal was used for power purposes.

The earliest attempts at manufacturing were upon an exceedingly simple scale, hence unbelievably tiny streams could be utilized for power. For example, the story is told that at Southbridge upon a branch of the Quinnebaug River, the manufacturer whose little shop has grown into the great American Optical Company was accustomed to employ a horse to furnish power when the brook ran dry in summer; and at one time a lusty negro was hired at ten cents an hour to turn the wheels. Power requirements so small as this did not necessitate large streams; therefore, wherever a brook flowed there a shop might be found, and the glacier had left the state a legacy of innumerable such waterways. Fire, flood, and failure wiped out many of the experiments in manufacturing and only a gaunt, naked water wheel on a broken raceway marks the scene of former activity; but not all the early attempts came to an end so evil, for many of the first little shops have grown into great plants, such as the American Optical Company just mentioned. The chief importance of the numerous little falls is that they encouraged so many men to try their fortunes in factory enterprises out of which the fittest have survived and placed Massachusetts among the leading American manufacturing states.

The age of small-scale operation did not last long, especially in Massachusetts' greatest industry, cotton cloth production, because improvements in machinery were made so rapidly and spinning frames and looms became so much larger and heavier that the small water-powers were utterly inadequate to drive the belts and turn the shafts; hence cotton manufacturing concentrated upon the large rivers. A case in point is furnished by the Boston Manufacturing Company, whose first mill at Waltham, built in 1813, was the earliest complete cotton factory in America, but which by 1825 was incapable of expanding to fit the enlarged requirements of the business because the stream was too small. The company bought a site on the Merrimac, at a point where it drops 32 feet, and brings to the use of man 30,000 horse-power, so that next to Holyoke it is the most valuable power in New England; there (in 1826) out of the woods the town of Lowell was brought to life. By 1850 Lowell had a population of 33,000 and was exceeded in size only by Boston. Along the banks

of its power canals there were 33 mills, but since there seemed to be no possibility of additional expansion, the group of men in control went farther down the Merrimac and selected the location[1] for a new village where Lawrence now stands. That city at present contains the largest woolen mills in the world.

At about the same time as the inception of Lawrence, plans were matured to erect on the Connecticut River within the confines of present-day Holyoke, a city which would be a second Lowell. In furtherance of this object a dam was built across the state's greatest river and when completed the Lyman Mills were established on the power site thus brought into use. Therefore, as the cotton industry grew, the wealth of small power sites was neglected and the few of the first magnitude developed, but large as well as small powers were a heritage of the glacier.

A similar advance from small streams to a great river is shown by the paper industry of the state. In the Berkshire Valley, where some of the first attempts to manufacture paper had been made, mills became a most familiar sight, for between 1800 and 1850, 27 paper-producing plants were built there. The town of Lee seemed in a fair way toward becoming a paper center of great importance, for there were no less than 18 mills within its boundaries. However, a change in paper manufacture took place which robbed Lee of most of its glory. The mills of which those at Lee were a type used but small amounts of power to reduce rags to a pulp. Frequently the Lee paper-makers formed the sheets by hand, for even the small, crude, easily operated machines often were not installed for this second division[2] of papermaking. A revolution was started when Foudrinier (1803) invented a machine that turned out a large amount of paper continuously, for this machine necessitated a great deal of power to keep it running. The machine alone took up as much room as a whole mill did previous to its invention. Furthermore, the machine called for a much enhanced amount of pulp, so that the pulp grinders were necessarily increased in capacity and consequently demanded more power to operate. The Foudrinier machine therefore paved the way for large-scale production, and made cheap power

[1] Develops 11,900 horse-power at 26-foot fall.

[2] Paper manufacture has three divisions: (1) reduction of raw material to pulp; (2) sheets, single or continuous, formed from pulp; (3) finishing.

a crucial factor. The greatest water-power in the state was established when the Holyoke dam was constructed, so the largest paper mills were built along the canals that cross the city, and it became the greatest writing-paper center in the country. There are a few famous mills in the Berkshire Valley, for example, the Z. and W. M. Crane, Old Berkshire Mills, the Pioneer Mills and the Government Mills, in which latter our paper for money is produced, but despite these noted exceptions the supremacy in high-grade paper-making rests with Holyoke and is founded on cheap power. Glacial action turned the Connecticut River from its true course at that point and in endeavoring to get back to its former path the river has cut across intervening ledges and falls 70 feet in 2 miles. The volume of the river is so great that this fall created 40,000 horse-power, a figure unsurpassed in New England. The influence of abundant cheap power changed the headship of the paper industry from ancient Lee to upstart Holyoke.

The paper industry, as well as the cotton, shows that first the small, then the large, powers enabled manufacturing to get a firm hold upon Massachusetts, and inasmuch as manufacturing is the greatest wealth-producer in the state and the products have made the state famous throughout the nation, the glacier has had no small share in shaping the destinies of the commonwealth and influencing the lives of the people.

4. GEOGRAPHIC INFLUENCES IN THE DEVELOPMENT OF NEW YORK STATE[1]

It is the chief purpose of this paper to show how four physiographic features, joined in a chain, lie at the foundation of the commercial and industrial leadership achieved by New York state.

Aside from part of Long Island, New York's entire coast line is comprised within the limits of one city. Nearly all of the original colonies have more shore line. New York pushes a wedge of land between New England and New Jersey, barely gets the thin edge down to the sea, but that narrow edge has proved to be worth more than any strip of coast on the seaboard of either America. A few facts may serve to impress this point.

[1] Taken from R. H. Whitbeck, "Geographical Influences in the Development of New York State," *Journal of Geography*, January, 1911, pp. 119–24.

Add together all of the exports from all of our ports on the Pacific, the Gulf, and the Atlantic (without New York), and they about equal those of New York alone. Add together all of the imports that come to all of our coast cities, except New York, and they do not equal the imports through this one city. Count all of the people who live in ten states in the western third of this country and they are less than those who live in New York City. Add together the value of all of the manufactures of all of the southern states—11 of them—and the total, splendid as it is, falls below the total of this single city. Add together the clearings of all of the reporting banks in the United States outside of New York, and they total but 60 per cent of the clearings of this city (in 1909).

At once the question arises, Why?

A full answer would be difficult. The causes that have brought it about are, of course, intricate. How much weight we may properly give to purely geographic causes is impossible to determine. That the underlying cause is to be found in a connected group of singularly favorable natural features is unquestionable. However, before discussing this dominant influence, I wish to mention briefly certain other geographical influences. Two factors have promoted manufacturing in the state: (1) nearness to the coal mines of Pennsylvania, and hence cheap fuel; (2) abundant water-power. Around the falls of the Genesee grew up Rochester, once the greatest flour-milling center in America. Along the Mohawk is a string of manufacturing cities and towns, forming the center of the knit-goods industry in this country. One of these cities, Cohoes, for years made half of the hosiery annually manufactured in the United States. Along the Black River and the Upper Hudson are chains of paper and pulp mills, built to utilize the water-power, and the spruce forests of the Adirondack region. This region is still the largest producer of wood pulp and paper. At Niagara Falls are the greatest power plants in the world. In the amount of water-power developed, New York leads all of the states.

In dairy products it still leads, notwithstanding the rapid growth of dairying in Wisconsin. The latter state is now said to make more butter and cheese, but it does not closely approach New York in the production of milk. Three geographical causes underlie this industry: (1) the demand for these products, especially for milk, in the many

cities in New York; (2) the preponderance of clay soil in large areas of the state. Such soil, because of its moisture-holding quality, supports the best meadows and pastures; (3) the hilly, almost mountainous, character of much of the state. These hill farms have much land that is too steep to till, but can be profitably pastured. Dairying is of small importance on the Ontario plain.

New York produces more apples than any other state and more grapes than any except California. The prize apple orchards are in the counties bordering on Lake Ontario. A yield of a million bushels a year is nothing unusual in one of these counties. Chautauqua County, on the southern shore of Lake Erie, is the grape belt; here are miles of vineyards. In case of both the apples and the grapes, a simple climatic influence explains the reason. It is the influence of the lakes in protecting the fruit from both spring and autumn frosts.

The southern part of New York belongs to the Alleghany Plateau. In it the upper branches of the Susquehanna have incised deep valleys. Many of them are more than a thousand feet deep. The only possible railway routes through the southern counties are through these valleys. By determining where the main railways should run, these valleys determined where industrial centers should be. The only two cities of any size are at junctions of these valleys. Three important railway lines connecting New York and Buffalo traverse these main valleys, the Erie, the Lehigh Valley, and the Lackawanna.

There is one negative geographical influence in New York that is sufficiently interesting to be mentioned. While Lakes Superior, Michigan, and Erie have large and important commercial cities, Lake Ontario has not a single one on the United States side. The barrier formed by Niagara Falls has entirely cut off Lake Ontario from any considerable participation in the enormous traffic on the Great Lakes.

While each of the foregoing influences has been a factor of importance in affecting the economic growth of the state, the chief influence remains to be discussed.

Without New York City, the state would hold only a medium rank in population, wealth, commerce, and manufacturing. For a hundred years Boston was a more important port than New York. In 1820 Philadelphia had about the same population as New York, and did an equally great amount of business. New York was by

no means the leading colony prior to the Revolution, or the leading state in the early days of the Republic. It was not until the United States began to grow into a commercial and industrial nation; not until the great interior, west of the Appalachians, became an actual part of the nation that the exceptional geographical features of New York state were realized. When people began to settle beyond the Appalachians in large numbers a new condition arose. The upper Mississippi Valley could turn its great resources into actual wealth only by connection with the eastern states and Europe, where lay a market for its products. So long as it cost more to deliver western wheat or corn or meat to the eastern coast than those products would sell for when they reached the East, there was little use of raising a surplus of crops in the West, no matter how cheap the land or how productive.

In the first decade of the nineteenth century, it cost $100 a ton to get freight from Buffalo to Albany. The development of the Middle West was absolutely dependent upon an outlet either to the east or to the south. For many reasons the latter was impracticable. To facilitate the trade between the East and the West, the famous Pittsburgh turnpike was built from Philadelphia to Pittsburgh. Products of western New York went down the Susquehanna and were shipped to Europe from Baltimore, or down the St. Lawrence by way of Montreal. The lead ore of Wisconsin reached New York by way of New Orleans. During all of this time, New York state seemed to be at a disadvantage. Then came the Canal Era, and New York's peculiar topography became the one determining factor in the future growth of the state.

When it began to appear that a waterway from the eastern seaboard to the West would so lessen freight charges to and from the West that the eastern terminal city of that waterway would command the vast trade with the interior, Baltimore, Philadelphia, and New York eagerly turned their attention to canals. The day of canal traffic has probably passed; but there is not the slightest question that the geographical conditions which made possible a canal from the Great Lakes to the Atlantic were the beginning of the phenomenal growth of New York and gave the state a momentum which has continued. A canal from Baltimore to the Ohio was attempted, built up the Potomac to Cumberland, but there it stopped. It stopped

because there was no gap by which a waterway could be carried across the mountains. Pennsylvania attempted a canal from the Delaware to the Ohio. It reached the foot of the Alleghany escarpment, but a canal cannot ascend a mountain wall, and no gap led to the Ohio; the Portage Railroad was built to carry goods over the divide, but this was only partially successful. To connect Philadelphia and Lake Erie by a waterway was impossible. South of New York, no water gap, no low pass leads across the eastern ranges. Consider, now, the conditions in New York.

1. The mouth of the Hudson is a drowned valley. The drowning has not only deepened the bay beyond the requirements of the largest ships, but it has produced several islands—Long, Staten, Manhattan, and others—which enclose the bay and greatly extend its water frontage. This made possible the building of the great number of piers without which New York's present shipping could not be handled.

2. The sinking of the land changed a small Hudson into a deep one with practically no current. From Albany to New York, 150 miles, the river falls only 5 feet. It is really an arm of the sea.

3. Westward from the Hudson extends the Mohawk Valley—"the Eastern Gateway of the United States." Here the Appalachian Mountain system is narrow and comparatively low. During the close of the Glacial Period, while the glacial ice still blocked the St. Lawrence, the Great Lakes drained to the sea by way of the Mohawk-Hudson Valley, cut a notch through the eastern mountain range and made a continuous valley. Thereafter the Mohawk headed west of the mountains and a low gap—the only one from Canada to Alabama—had been opened across the Appalachian highland.

4. From the Mohawk westward is a plain 20 to 30 miles wide, leveled by the scraping and filling of the ancient glacier. So level is this plain that one reach of the Erie Canal is 50 miles long without a lock. The only difficulty was encountered in rising from the Ontario plain to the higher level of Lake Erie, necessitating a series of locks at Lockport.

For fifty years the Erie Canal, twice enlarged, carried an enormous traffic. Freight rates dropped as low as a dollar a ton from Buffalo to Albany. The surplus products of the Middle West poured through

it and New York City soon outstripped all competitors. Had the physiography of Pennsylvania or of Maryland, instead of that of New York, been favorable for the canal, Philadelphia or Baltimore must, it seems probable, have been more important cities than New York.

Not alone did the canal (and the trunk line railroad which later followed the same route) build up the city of New York, but the same influences built up other parts of the state, for other canals connected Lake Champlain, Lake Ontario, the Finger Lakes, the Black River, and the Genesee Valley with the Erie Canal. No other state had such a system of inland waterways, because no other eastern state had such a favorable physiography. The overshadowing importance of this trade route from the Atlantic to the lakes may be seen from such facts as these: (1) New York is a state of large cities and every one of them is along the canal route (including, of course, the Hudson). The largest city not on this route, Binghamton, has somewhat more than 50,000 people. The population of the cities in the canal counties is more than twenty times as great as the city population outside those counties; (2) the population of the 30 canal counties is about nine times as great as that of the 30 non-canal counties; (3) the assessed valuation of these 30 canal counties is about ten times that of the other 30 counties; (4) the excess of the value of manufactures in the canal counties over the remaining part of the state is equally great.

It is not to be understood that the Erie Canal is the cause of all this. The canal was a big factor. The New York Central Railroad, which parallels the canal with four tracks, has been and is a large factor. The noteworthy point is that a combination of harbor, drowned river, low gap through the mountains, and level lake plain—all physiographic features—have exerted a preponderant influence in the making of the Empire State. It was the canal that, for several decades, brought to New York City the major part of western shipments, and which gave that city unequaled advantage in supplying western trade. It was the big export shipments brought to New York by the canal that made that city the one American port where trans-Atlantic ships were most sure of finding a cargo, and gradually made that harbor the point on which railway lines from all states, and steamship lines from all seas converged and exchanged traffic.

Conclusion. A variety of factors, both geographic and non-geographic, have combined to direct the economic development of New York. Without any considerable mineral wealth of its own, it fortunately lies next to the greatest mineral-producing state of the Union. The ungraded courses of many of its rivers, chiefly due to the work of the glacier, have supplied water-powers of great value. The hilly topography and clay soil have favored dairy farming in a large part of the state and made it the first state in dairy products. The climatic influence exerted by Lake Erie and Lake Ontario has resulted in extensive fruit raising, making New York first in the production of apples and second only to California in the production of grapes.

But the one dominant influence which has promoted the development of the state in manufacturing, in commerce, in wealth, and in population lies in a chain of four unique physiographic features. These features are (1) the deep, inclosed, spacious harbor produced by drowning the mouth of the Hudson River; (2) the deep, navigable river itself leading 150 miles inland; (3) the low gap through the eastern mountains, cut by the Mohawk; and (4) the glacially leveled plain which joins the Mohawk Valley to the Great Lakes. Out of these four conditions grew the waterway that gave the chief impetus to the growth of the state, and particularly to the growth of its largest city.

5. GEOGRAPHIC INFLUENCES IN THE DEVELOPMENT OF THE MANUFACTURING INDUSTRY OF THE MOHAWK VALLEY[1]

The Mohawk Valley is one of the busiest manufacturing sections of our country. From source to mouth, there is an almost continuous chain of bustling mill towns along its banks. In these towns are produced 59 per cent or more of the gloves and mittens made in the United States; nearly half of all the knit goods; 10 per cent of the carpets; and a large part of the cotton goods. Here will be found the largest typewriter works in the world; one of the largest factories for the manufacture of dynamos, motors, and electrical supplies;

[1] Taken from George B. Roorbach, "Geographic Influences in the Development of the Manufacturing Industry of the Mohawk Valley," *Journal of Geography*, November, 1911, pp. 80–86. Mr. Roorbach is professor of foreign trade at Harvard University.

great establishments for the manufacture of locomotives, brooms and broom machinery, firearms, cabinets and furniture, canned vegetables, and miscellaneous wares of all kinds, not to mention those manufactures dependent upon dairying—butter, cheese, and condensed milk.

A larger proportion of the people of the Mohawk Valley are engaged in the manufacturing industries than are similarly engaged in the city of New York. Taking the six counties that include most of the area of the valley—Albany, Schenectady, Fulton, Montgomery, Herkimer, and Oneida—in 1907, out of a total population of 527,690 men, women, and children, there were 110,428 wage-earners in industrial plants, or nearly 21 per cent of the total population. The percentage in New York City for the same year was 16 while in the whole state but 14.8 per cent of the inhabitants were engaged in manufacturing.

The Beginnings of the Manufacturing Industry. Grist mills for the grinding of grain were in most cases the first mills of any kind to be built, following soon after houses and barns had been erected and a season or two of crops had been gathered. In certain cases saw mills or oil mills for grinding flaxseed preceded the grist mill; often the three were combined in one mill. Invariably these were located on some tributary stream which could furnish power; and such power sites were numerous, for nearly every stream flowing into the Mohawk enters the river with steep gradients, in narrow valleys, and in many cases over waterfalls.

Geographic Factors Favoring Manufacturing. The chief geographic factors that have determined this large industrial development during the past century may be grouped under three heads:

1. Water-power resources
2. Accessibility to coal
3. Accessibility to raw materials and markets

Water-Power Resources. The presence of abundant water-power was especially important in the early history of manufacturing. With the use of the steam engine and the discovery of the great coal deposits of Pennsylvania, water-power became of less relative importance, but it is again beginning to assert its value and the development of unused water-power is now taking place. The relation of the earliest mill sites to sources of water-power has already been mentioned.

Of the New York State rivers within the boundaries of the state, the Mohawk is exceeded in amount of water-power development only by the Hudson, the Black and the Oswego rivers, and in total power available only by the Hudson, Raquette, and Black. The total available power of the Mohawk system is approximately 182,500 h. p. of which 42,698 h. p. is developed in one hundred and eighty-eight different plants.

The Mohawk River itself—a mature, well-graded stream—furnishes power at but two important localities: at Cohoes, where the river enters the Hudson through a new channel which it was forced to cut at the close of glacial times, and at Little Falls where, also after the glacial period, the old pre-glacial river flowing westward from Little Falls, was compelled to change its direction and join the Mohawk by flowing over the cliffs of hard rock at that place. Of these two localities Cohoes has much the greater power, both because of the greater fall and because of the increased volume of the river at this point. The river here falls a distance of 105 feet and is capable of furnishing from 12,000 to 150,000 h. p., the two figures representing the minimum and maximum as determined by the volume of water during dry or wet months. The total minimum power of this stream is now developed, it being the largest single water-power development in the Mohawk basin. It was because of this power that the knit goods industry was established at Cohoes and has grown to its present large proportions.

At Little Falls the river enters a narrow gorge and, in a distance of one-half mile, falls about 45 feet, making a possible development of from 2,000 to 40,000 horse-power, the present development being 1,844 horse-power. Many of the knitting mills here using water-power require large steam auxiliary. Water-power at present furnishes much the smaller amount of power required for the factories.

The total power developed by the main channel of the Mohawk is 14,336 horse-power or 33.6 per cent of the power furnished by the entire Mohawk system. Most of this, as shown by the preceding paragraphs, is at Cohoes.

The northern tributaries of the Mohawk take their rise in the high Adirondack region in the part of the state that receives the heaviest rainfall and that is largely covered by forests. These tributaries are also much longer than the southern. Hence it is that

the flow of water in these streams is larger and more regular than in the southern tributaries and that the largest power development has here taken place. Nearly 20,000 horse-power, or 46 per cent of the power developed in the Mohawk system, are now being generated by these streams. The southern tributaries furnish but 8,600 horse-power. With the advent of the factory system, the wide distribution of these water-power streams greatly encouraged the establishment of industries and it was along these tributary streams that most of the early factories were built, notably along the Chuctanunda (at Amsterdam), the Çayadutta (between Fonda and Gloversville), the East Canada (at Dolgeville), the West Canada (at Herkimer), and the Saquoit and Oriskany (near Utica).

With the multiplication of mills, however, combined with the diversion of water to the feeders of the Erie Canal and the increased irregularity of stream flow as deforestation went on, water-power became inadequate to supply the demand. Either the streams could not furnish power for projected mills, or they were found to become increasingly unable, during the summer months, to turn the wheels already installed. Low-water records became lower each summer, while floods became more unmanageable. If the Mohawk Valley was to develop its manufacturing industries, which it had begun, a new source of power was imperative. Fortunately, such new and auxiliary power was near at hand in the form of coal.

Accessibility to Coal. The anthracite coal fields of Pennsylvania lie but a short distance to the south of the Mohawk Valley and are readily accessible by way of the Susquehanna River and its tributaries. The distance from Scranton to Utica is about 125 miles, as compared with 100 miles to either New York or Philadelphia. From the Scranton-Wilkesbarre coal fields, the railroads bring the coal up the Susquehanna Valley and there, like the fingers of a hand, they reach into the valley of the Mohawk. In the western part the Ontario and Western reaches Rome and Utica via the Chenango and the Oriskany valleys, while the Delaware, Lackawanna and Western comes into Utica via the Unadilla and Saquoit valleys. In the eastern end of the valley, the Delaware and Hudson reaches Schenectady via the Susquehanna and Cobleskill valleys. The Lehigh Valley Railroad also reaches the Mohawk Valley lowland just west of the low divide at Canastota. Thus, nearly all the great

anthracite railroads closely connect the factories of the Mohawk with the potential energy of the Pennsylvania coal fields, through the passes afforded by these valleys.

Likewise the soft coal of western Pennsylvania is brought to the Mohawk Valley wholly by rail or by rail to junction points of the coal-carrying roads with the Erie Canal, and thence by barge to the very doors of the factory.

With the development of electrical transmission of power, the Mohawk Valley is entering a third stage of power utilization in which water, as the ultimate source of power, is regaining its former place. The northern tributaries are a great asset to the industry, coming as these streams do from the high, forest-covered Adirondack region with its abundant rainfall. The creation of the great Adirondack preserve means the perpetuation of the flow of the streams having their sources there; the many lakes act as natural reservoirs, and the topography offers many opportunities for the cheap construction of artificial reservoirs. The nearness of the Mohawk to these mountains means rapid fall of the streams as they cross the valley and hence power sites near at hand from which electric power can be distributed up and down the valley. Already east and west Canada creeks and other streams have been harnessed for this purpose furnishing power and light to Utica, Little Falls, Gloversville, and many other manufacturing towns.

Electric power can also be brought to the Mohawk from the large power sites on the Upper Hudson. The cities of the eastern end of the valley are very near these power centers and even the bringing of such power to a city as far distant from the Hudson as Utica has been seriously considered. The western part of the valley is also well within reach of the power generated at Niagara Falls, Utica, for example, being less than 200 miles from this center.

A possible future source of electric power is offered, furthermore, by the nearness of the coal fields of Pennsylvania. With the generation of electric power at the mine mouth (a development which is already assuming importance), Mohawk Valley towns lie well within the radius of economical distribution of such power.

Judged by power available, the continued growth of manufacturing industries in the Mohawk Valley seems assured.

Access to Raw Materials and Markets. The third factor that has insured the industrial development of the Mohawk Valley is the ease of transportation, opening the valley to the ingress of raw materials and offering ready means of marketing manufactured goods. The navigable Hudson has brought the sea to the very mouth of the valley, connecting the great harbor of New York with Troy and Albany. From the head of navigation on the Hudson, access to the interior has been easy, first by river and road, later by canal and lastly by two great railroads and an enlarged canal. Thus, even points as far distant as Utica and Rome, in the western part of the valley, 250 and more miles from the sea, are so connected by land and water with the great seaport at the mouth of the Hudson that it has little disadvantage from its inland position. Likewise to the west, with the great interior of the continent, connection is almost equally easy, bringing, via the Great Lakes, the Erie Canal and the great railroads, the supplies of food and raw materials from that region and furnishing access to a market of unsurpassed excellence. To the north also, via the Black River Valley and the St. Lawrence on the one hand, and the Champlain lowland on the other, communication with the northern part of the state and with Canada is almost equally easy.

Thus the Mohawk Valley is not simply a great highway. It is a center possessing, by virtue of its own resources and its connection with surrounding sections, the conditions that favor manufacturing development. These factors would inevitably have favored some kind of manufacturing. In many instances the particular kind of industry has been determined by some factor other than geographic. Thus the establishment of the glove industry was due largely to the presence of Scotch "glovers" among the early settlers in Fulton County; the knitting goods industry received its start in the Mohawk Valley because of the inventive genius of an inhabitant of Albany; the gun factory at Ilion, because a country boy, unable to buy a gun, succeeded in making a gun barrel at a small village forge. Other industries, as the manufacture of brooms, of lumber, of glass, and the canning of vegetables, have developed because of the presence of raw materials in the valley. Such industries, however, are relatively insignificant compared with those which receive many, if not all, of the materials of manufacture from distant points. Manufacturing

industries have developed in the Mohawk Valley because of unusual advantages of location combined with her own power resources and ready accessibility to the power locked up in the coal of Pennsylvania.

6. THE RELATIVE IMPORTANCE OF THE NEW YORK CITY METROPOLITAN DISTRICT[1]

New York City Metropolitan District. The New York City metropolitan district embraces 616,928 acres of territory, of which 183,555 acres constitute the area of New York City, and 433,373 acres the area of the outside territory. The estimated population of New York City in 1914 was 5,333,539 and that of outside territory 1,923,846, the total for the district being 7,257,385.

In 1914 the New York City metropolitan district had 36,410 manufacturing establishments, which gave employment to an average of 1,031,815 persons during the year, 842,103 being wage-earners, and paid out $711,085,669 in salaries and wages. These establishments manufactured products to the value of $3,428,223,150, to produce which materials costing $1,984,842,079 were utilized. The value added by manufacture was $1,443,381,071. The district ranked first in 1914 among the metropolitan districts of the United States in the value of its products. It represented 12.5 per cent of the persons employed, 11.5 per cent of the capital, and 14.1 per cent of the value of products reported for the entire country.

The greater part of the value of the manufactured products of the district was reported by factories within the central city. New York City contains nearly three-fourths (73.5 per cent) of the estimated population of the district, and contributed more than two-thirds (66.9 per cent) of the value of products in 1914. The corresponding percentages for 1909 were 73.6 and 68.3, respectively, which indicates that the increase in population and in the manufactures of the central city have not kept pace with the growth of the district as a whole. In 1914 the manufacturing establishments of New York City constituted over four-fifths (81.4 per cent) of all in the district, and gave employment to nearly seven-tenths (69.5 per cent) of the wage-earners. Outside of New York City, Newark was the leading city within the district both in value of products

[1] Adapted from *Census of Manufacturers*, I (1914), 989–90.

and in population, its products representing 6.1 per cent and its population 5.4 per cent of the total for the metropolitan district.

The population of the district, outside the cities and towns for which separate figures are given, was 4.7 per cent of the total for the district, and the value of manufactures produced in this territory formed 4.9 per cent of the value of the products for the district.

7. THE RELATION OF THE PORT OF NEW YORK TO THE FOREIGN COMMERCE OF THE UNITED STATES[1]

New York district's share of the total foreign commerce of the United States in 1918 was 42.36 per cent. In 1917 the corresponding proportion was 44.69 per cent, as compared with 52.76 per cent in 1916, 46.59 in 1915, 45.98 in 1914, 49.15 in 1913, 46.99 in 1912, and 46.12 in 1911.

TABLE XXX

THE EXPORT AND IMPORT MOVEMENTS OF THE UNITED STATES AND OF THE DISTRICT OF NEW YORK BY TEN-YEAR PERIODS FROM 1870 TO 1910 AND FOR EACH YEAR FROM 1915 TO 1918*

Year	New York		United States		New York's Percentage of Whole	
	Imports	Exports	Imports	Exports	Imports	Exports
1870	$ 281,000,000	$ 197,000,000	$ 436,000,000	$ 393,000,000	64.4	50.0
1880	460,000,000	392,000,000	668,000,000	836,000,000	68.8	46.9
1890	516,000,000	349,000,000	789,000,000	858,000,000	65.4	40.6
1900	537,000,000	519,000,000	850,000,000	1,394,000,000	63.2	37.2
1910	936,000,000	652,000,000	1,557,000,000	1,745,000,000	60.1	37.3
1915	931,000,000	1,193,000,000	1,674,000,000	2,769,000,000	55.61	43.11
1916	1,192,000,000	2,332,000,000	2,198,000,000	4,339,000,000	54.22	53.8
1917	1,338,000,000	3,053,000,000	2,659,000,000	6,290,000,000	50.32	48.53
1918	$1,251,000,000	$2,613,000,000	$2,946,000,000	$5,920,000,000	42.48	44.14

* Figures do not include specie. Exports include foreign as well as domestic merchandise.

8. THE SIGNIFICANCE OF THE POSITION OF NEW JERSEY[2]

One who studies the industrial development of Pennsylvania sees a single geographical influence which overshadows all others. It is the influence of her mineral wealth—five times as great in value of yearly output as that of her nearest rival.

[1] Adapted from *Sixty-First Annual Report of the Chamber of Commerce of the State of New York*, Part II, pp. 128, 35.

[2] Adapted from R. H. Whitbeck, "Geographical Influences in the Development of New Jersey," *Journal of Geography*, January, 1908, pp. 177–82.

One who studies the industrial development of New York sees again a single dominant geographical influence. He finds eight-tenths of her people and nine-tenths of her wealth in the row of counties touched by the Erie Canal and the lower Hudson. The influence of this waterway, terminating in a splendid ocean harbor, has been the paramount geographical condition in the making of New York City and New York state.

One who studies the industrial development of New England sees the far-reaching influence of her waterfalls. Even as recently as 1870, 72 per cent of New England's manufacturing was done by water-power.

In each of these cases and many others the molding influence in building up a state has been something within the state itself; its minerals, its physiography, its soil, or its water-power. Not so with New Jersey. It has but limited mineral wealth and little water-power. Three-fifths of its soil is now yielding little of commercial value. Two hundred and fifty miles of its coast have no commercial harbor and no commercial town with much more than local interests. Yet, with all of these seeming handicaps, New Jersey stands among the foremost industrial states, it ranks sixth in the total value of its manufacturing (1914). Strangely enough, this industrial development goes on with very little dependence upon the natural resources of the state. In this growth, one geographical influence overshadows all others and intensifies all others.

The capital invested in manufacturing in this small state at the present time is far greater than was so invested in the entire United States fifty years ago. That a state's manufacturing should be so great and at the same time so independent of its own production of raw materials, fuel supply, and water-power, is noteworthy.

According to the federal census of 1900, the smelting and refining of copper was, in point of value of product, the greatest manufacturing industry in the state. This is practically all done in a single plant near New York Bay. The ore comes from nearly every copper-producing region in the world, yet not an ounce of the ore or of the coal for smelting it comes from New Jersey. Second in rank among the manufactures are iron and steel products. Yet only a small fraction of the iron ore used comes from the state. Third in rank is the refining of petroleum (second in 1914), not one drop of

which was produced in New Jersey. Fourth in rank by the census grading, but really first in importance, is the manufacture of silk (third in 1914). This industry, centering in the city of Paterson, employs nearly 30,000 people, and represents an invested capital more than ten times as great as was invested in this industry in the entire United States in 1860. Yet every fibre of the raw silk is imported into the state. The manufacture of leather and leather goods is fifth in importance (tenth in 1914). Then follows malt liquors (fourteenth in 1914) and slaughtering and meat packing (sixth in 1914). It is not until we reach brick, tile, pottery, and other clay products and glass, respectively fourteenth and twenty-fourth in rank among the state's manufactures (sixteenth and forty-third in 1914), that we find any close relation between the natural resources of New Jersey and her manufacturing industries. Why, then, are these plants located there? Let us see. Fully 70 per cent of the capital invested is in plants located close to New York. Some are on the water front. All are close to the great coal-carrying railroads. It is evident that New Jersey is undergoing its remarkable industrial growth, not because of its own natural resources, but because of its unique situation between two great markets, two great ports, and within a short distance of coal.

New Jersey's situation has given her unequalled transportation facilities, both by rail and by water. At her water front on the lower Hudson nearly all of the eastern trunk lines and ocean routes to all the world meet.

The Manufacturing District of Northern New Jersey. Here in northern New Jersey is one of the clearest examples of the influence of topography. Running north and south on the Jersey side of the Hudson is the Palisade Ridge. About ten miles farther west and nearly parallel to the Palisades, is another massive ridge of trap rock some three or four hundred feet high, very steep on the eastern side and not cut by any low gap for a distance of about eighteen miles. No main lines of travel have found it practicable to cross the barrier within this distance. Westward from the Hudson the expanding population has pushed its way. Here are large areas of swamp locally called meadows. A generation ago they were worse than worthless. Today they are being purchased, or already have been purchased, at fabulous prices, and are being filled in at

enormous cost, to be used as sites for manufacturing and commercial establishments. Farm lands in this valley have passed into towns and towns have grown into cities and cities have grown together so that only a line separates them. The wave of urban population has rolled westward to the foot of First Mountain; it has pushed northward and southward along the valley and through the gaps at either end, but where it struck the steep face of First Mountain, there it stopped. This mountain cuts Essex County into two nearly equal parts, one-half lying toward New York, the other half toward the west. On the east is a swarming population, and all that goes to make up a metropolitan district. On the western side of the ridge the farmer tills his acres and cows roam over the pastures. In this half of Essex County live 3 per cent of its people. In the other half live 97 per cent. And the barrier that divides the halves is less than 400 feet high.

In a narrow strip of land extending from the lower Hudson to the lower Delaware, and comprising one-sixth of the area of the state, live four-fifths of the people of New Jersey. In this limited area is concentrated nearly all of the manufacturing of the state. Outside of this narrow strip there is no important business city. There must, of course, be some geographical reason for this. Through the middle of this strip of land ran the ancient trail of the Lenni-Lenape; ran, a little later, the old Dutch road; ran, still later, the King's Highway from New York to Philadelphia, over which famous road the flying mail coaches carried passengers in the brief period of three days. Along this same course goes the Delaware and Raritan Canal, which may ere long be a link in our projected inshore waterway along the Atlantic Coast. And along this same narrow strip run the four tracks of the main line of the Pennsylvania Railroad. This route has been from the days of the red man a main artery of travel, for it furnishes an almost perfectly level path across the state. This route is, and is destined to be increasingly more, a link in America's chief highway of transportation.

The Pine Belt. New Jersey presents some interesting and striking contrasts. You may live in Lakewood in the Pine Belt at one of the most sumptuous hotels in the world; mingle with the most fashionable society in America; in fact, be among the social refinements which belong only to the centers of wealth and cultiva-

tion. Yet, a few miles away you will find people almost as primitive as the mountaineers of the South; dwellers in cabins that know not carpets or paint, and whose adult occupants not infrequently go barefooted. Here in the Pine Belt of New Jersey, not far from the great city of New York, live the huckleberry pickers of the pines; yet they are seemingly untouched by the influence of urban civilization.

The Coast. Along the shallow bays that fringe the coast between Point Pleasant and Atlantic City live another type of people, locally called the Baymen. This stretch of coast has as yet been but slightly invaded by the summer resorts. The bays are shallow and are visited only by fishing craft and small coasting vessels. On such a coast no trunk line terminates. No ships sail in and out to foreign ports. The shallow water and the hidden bars have left the fishing villages to work out alone their own peculiar type of men. And they are indeed the product of their environment. The wealth of the sea lies at their very doors. They know that there is no danger of hunger. They can go to the bay at any time and in a few hours capture clams or oysters for their own food and find a cash market for the surplus. The bay has never failed them and they have no fear that it ever will. Why should they take thought of the morrow? Tomorrow will take care of itself as it always has done. Such a condition must make and does make men thriftless and improvident. It must and does encourage idleness, and make steady labor irksome.

But conditions along a part of this coast are rapidly changing. The type of coast which has repelled oversea commerce and has left the oysterman and clammer unmolested is exerting its influence in quite a different direction. In and near New Jersey has grown up a dense and wealthy urban population, a class of people who seek summer homes and summer hotels within easy reach of the cities. Those very conditions which unfit the Jersey coast for commerce are the conditions which qualify it for summer homes and hotels. Along this coast for miles extends an almost unbroken line of palatial residences, clubhouses, and resort towns. Further south are the fishing villages, and Atlantic City, the city of a thousand hotels. This notable expansion of seaside resorts is due to two geographical influences: the type of coast; and, more important still, the nearness of that coast to the great centers of wealth and population. To these resorts come visitors by the tens of thousands. Their demand

for products fresh from the farm and dairy is one of the potent influences that stimulate farming in New Jersey and make it a Garden State.

Agriculture in New Jersey. It cannot be maintained that nature designed New Jersey for an agricultural state. With all its advantages of markets and transportation, one-half of the state is still covered with forest and underbrush. The southern three-fifths of the state is coastal plain; low, sandy, half-covered with pine and oak, thinly peopled, and without cities of any size except on the outer margins. Half of North Jersey is rough, thin-soiled, and considerably forested. Nevertheless, in the value of farm crops per acre, New Jersey leads all of the states.

The general character of New Jersey agriculture is indicated by the fact that more than one-third (34.9 per cent) of the total value of crops in 1909 was contributed by potatoes and other vegetables, while about one-fourth (24.3 per cent) was contributed by the cereals, and less than one-fifth (18.9 per cent) by hay and forage. The remainder representing in value about 22 per cent of the total, consisted mostly of flowers and plants, nursery products, orchard and nuts, and small fruits (*Thirteenth Census of the United States*, VII, 130).

The reason for this specialization in truck and garden crops is in part due to the character of the soil but largely it is the same one that explains the industrial development of the state generally; *the influence of geographical position.*

9. THE NORTHERN APPALACHIAN COAL FIELD[1]

Geographic Relations. The Appalachian coal field extends from the northern border of Pennsylvania southwestward, a distance of 800 miles, to central Alabama. Its greatest width is about 180 miles near its northern end, from which it tapers gradually southward to less than 20 miles in Tennessee, and then expands to about 80 miles in Alabama. It embraces portions of nine states, and has a total estimated area of 70,000 square miles. It is by far the most important of the bituminous coal fields of the United States in extent, in the quality of its coal, the number and thickness of workable beds, the

[1] Adapted from David White, M. R. Campbell, and R. M. Haseltine, "The Northern Appalachian Coal Field," *Twenty-Second Annual Report of the United States Geological Survey*, pp. 125–226; *Mineral Resources of the United States*, 1915, pp. 367–70, 453, 455, 457, 461; J. A. Bownocker, "The Coal Fields of Ohio," *United States Geological Survey, Professional Paper 100-B*, pp. 35–36, 86.

Map 9.—Production of Coal in North America in 1913[1]

Each • represents 1 per cent of world's production
Each x represents $\frac{1}{2}$ to $\frac{1}{10}$ per cent of world's production
Each v represents less than $\frac{1}{10}$ per cent of world's production
Coal fields other than lignite are outlined

[1] Reproduced from World Atlas of Commercial Geology, *United States Geological Survey*, 1921, Part I, Plate 2

state of development, and in importance and accessibility of its markets. While this field is a unit in respect to its chief geological characteristics, usually it is subdivided for convenience of treatment into a northern and southern field. The northern Appalachian coal field embraces that portion of the whole field which lies in Ohio, Pennsylvania, Maryland, and West Virginia.[1]

Geologic Relations. The coal-bearing formations of the northern Appalachian field belong to the Carboniferous system. They consist for the most part of shales, sandstones, and conglomerates, with occasional beds of limestone, fireclay, and coal. In general, the formations show a gradual thinning from the eastern margin of the field westward, and there is also a decrease in the number and thickness of the coal beds in the same direction. This westward thinning of both rock formations and coal is observable only in a general way, however, and many local exceptions are found. The eastern margin of the field borders upon the belt of steeply folded strata that forms the Appalachian Valley, and along this margin the coal-bearing formations have also been considerably folded. The folding becomes less pronounced toward the west, and in the central and western portions of this field the strata are either practically horizontal or occur in very gentle undulations.

The Pittsburgh Bed. The Pittsburgh bed or seam is the most uniform in quality and thickness and, for a given area, the most valuable coal bed in the bituminous coal field of Pennsylvania. It occupies an area in this state of about 50 miles in length and breadth, with an average thickness of presumably about 6 feet. On this basis it is estimated that the Pittsburgh coal bed originally contained more than 10,000,000,000 tons of available coal. In quality the coal of the Pittsburgh bed is for many purposes equal if not superior to the best bituminous coal found elsewhere in the Appalachian field or in the world. It is an excellent domestic and steam fuel. It mines in large blocks, which withstand the rough usage incident to long shipments and frequent breaking of bulk, and consequently is well adapted for

[1] [Most of the coal in this field is in the Allegheny Plateau which lies in the eastern part of the Ohio drainage basin. The area of largest production is in southwestern Pennsylvania and is drained by the Allegheny and Monongahela rivers. The area second in importance is in southern West Virginia in the basins of the Kanawha, New, and Big Sandy rivers.—C.C.C.]

export and the more distant home markets. It is a high-standard producer of illuminating gas, containing, in portions of the field, from 36 to 38 per cent of volatile combustible matter. For the manufacture of coke the Pittsburgh has few if any equals in the United States, in fact it is the standard gas and coking coal in North America.

The Pittsburgh bed extends southward into northern West Virginia and westward into southeastern Ohio. In 1918, 53 per cent of the bituminous coal in Pennsylvania and 38.6 and 15 per cent respectively of all the coal in Ohio and West Virginia was produced from this bed.

Methods of Mining. All but a small percentage of the bituminous coal mines in Pennsylvania are worked by drift on the outcrop or by gentle slope down the dip of the bed. Deep mining, as the term is employed in Europe or in the exploitation of metalliferous deposits, is practically unknown in this territory.[1]

At the greater number of the large mines, in all portions of the field, rope, electric, compressed air, or steam haulage has been introduced, and machine mining by electricity or compressed air is now extensively employed. In fact, 55.6 per cent of the bituminous coal produced in Pennsylvania in 1915 was mined by machines.

Mining conditions in the greater part of the bituminous regions, where the beds are quite regular and approximately horizontal, are quite different from those in the Pennsylvania anthracite region, where the beds are steeply inclined, faulted, and folded, and the methods pursued in recovering the coal are therefore quite different in the two areas. Machine mining in the anthracite region has not been developed to any great extent, and less than 2 per cent of the total product is recovered in that manner.

Distribution of Coal. The distribution of the production of the bituminous coal mines in the northern Appalachian field is governed largely by the geographic positions of the mines with reference to the main body of the field and to the direction of the communicating railways. To a certain extent the distribution is especially adjusted

[1] [As the surface of the Allegheny Plateau is characterized by numerous deep valleys developed by the complex network of streams which drain it, and, as most of the coal beds lie within a few hundred feet of the surface, the upper coal beds outcrop along many of the valleys slopes and coal is mined extensively along such exposures. Moreover, these valleys make the lower coal beds accessible by relatively short shafts.—C.C.C.]

to the qualities of the fuel; but ordinarily, unless the product has some special or important adaptation, the markets are so favorably situated that the coal is apt to move east or west or north according to its initial geographic position. The southward movement is to a great degree an exception to this rule.

Pennsylvania. The greatest coal-producing state, Pennsylvania, is also the greatest coal-consuming state. Doubtless other factors than the quantity and accessibility of its coal have influenced to some degree the location within its boundaries of the countless industries that now add to its wealth, but it is doubtful whether any other factor has been so potent. In 1915 nearly 60,000,000 net tons of bituminous coal—38 per cent of the output of Pennsylvania in that year—were consumed within the state in making coke and in manufacturing and mining. More than 40,000,000 tons, or 26 per cent of the total, were shipped to other states by rail for uses other than as railroad fuel. About 14,400,000 tons were used in New York; 7,200,000 tons in Ohio; 6,500,000 tons in New England; and nearly 3,500,000 tons in New Jersey. Between 1,000,000 and 2,000,000 tons each were shipped to Maryland, Illinois, and Michigan, and the remainder was used in 25 other states, from the Pacific Coast to the South Atlantic states. In 1915 the shipments to the Great Lakes for cargo were more than 9,600,000 tons, or 6 per cent of the output, the shipments to tidewater were 13,960,000 tons, or 9 per cent, and the exports by rail to Canada were 3,866,406 tons, or 2 per cent. Nearly 34,200,000 net tons were used by railroads, of which 3,436,000 tons were consumed in the Great Lakes region and shipped by the Lakes. Nineteen per cent was shipped by rail for use of railroads.[1]

West Virginia. The coal industry of West Virginia has been developed under unique conditions. There has been little home market, so the operators had to seek markets for their coal in other parts of the United States and in foreign countries. Immense reserves of high-grade coal in easily workable beds have permitted mining on a large scale and at low cost. Proximity to the Atlantic

[1] [The bituminous coal fields of Pennsylvania are penetrated by the numerous lines of the Baltimore and Ohio, Pennsylvania, New York Central, and Erie systems, as well as by a number of less important railroads. Because of the complex relief of the Appalachian Highland these railroads reach the coal districts by following the river valleys. The main line of the Pennsylvania Railroad

seaboard, where good harbors afford opportunity for foreign and coastwise shipments, and excellent railroad outlets to the markets of the West and Northwest have enabled the coal industry of the state to develop at a rapid rate.

Including the coal made into coke at the mines and that used for steam and heat at the mines, the consumption of West Virginia coal in that state in 1915 was but 6,000,000 net tons, or 8 per cent of the total output. More than 32,500,000 net tons, or 42 per cent of the output, was shipped to other states by rail or by river, for use other than as railroad fuel. The shipments to the Great Lakes for cargo were 8,700,000 net tons, or 11 per cent of the total, and shipments to tidewater were more than 20,400,000 tons, or 27 per cent of the output. The Lake cargo shipments included 800,134 tons for railroad use in the Northwest, and the tidewater shipments included 1,776,419 tons sent by vessels coastwise to New England and used there by the railroads. The quantity of railroad fuel that reached its destination by all-rail routes was 9,478,401 net tons, or 12 per cent of the production in 1915.[1]

Ohio. Ohio uses large quantities of coal and in 1915 ranked fourth in the production of coal. Between 9,000,000 and 10,000,000 tons, or about 43 per cent of the coal produced in Ohio in 1915, was used in the state, so it is evident that the local markets are the most favorable for Ohio coal producers. The railroads used about 7,900,000 tons, or 35 per cent of the output in 1915, and 75,000 tons, or 1 per cent, was shipped to tidewater or exported to Canada by rail. The coal shipped from mines in Ohio to other states in 1915 for use otherwise than as railroad fuel amounted to 2,317,036 tons, or 10 per cent of the output in 1915. More than half this quantity went to Michigan

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follows the valley of the Juniata, a tributary of the Susquehanna, across the ridges and valleys of central Pennsylvania, climbs the Allegheny Front by means of its famous horseshoe curve and crosses the plateau to Pittsburgh, following for a considerable distance the valley of the Conemaugh. The main line of the Baltimore and Ohio crosses the highland by utilizing the valleys of the upper Potomac and the Youghiogheny, a tributary of the Monongahela.—C.C.C.]

[1] [The Chesapeake and Ohio and the Norfolk and Western are the principal railroads serving the coal districts of southern West Virginia. These roads cross the divide between the James and Ohio drainage basins at a point where the head streams of the James are near the upper reaches of the New River, one of the upper tributaries to the Ohio.—C.C.C.]

and the greater part of the remainder to Illinois and Indiana. Little coal goes from Ohio to market by all-rail routes, except to these three states. Ohio is one of the four states that ship coal to market northwestward by the Great Lakes. The lake shipments from this state in 1915 were 2,482,615 tons, or 11 per cent of the output.

The coal fields of Ohio are well supplied with railroads, being crossed by several of the large east-west systems and by other roads, which lead directly to the Great Lakes. These main lines, together with their many branches, make accessible almost all parts of this large region. Further, the area is not far from the center of population of the United States. These facts have made Ohio one of the large coal-producing states. In 1915 it ranked fourth in coal mined, and its output was over 6 per cent of the total for the United States. The Ohio River, which has trenched its way through the coal fields from Pittsburgh to a point below Ironton, should be one of the great highways for the movement of heavy freight, such as coal, but the shallowness of its water during the summer has prevented the development of such a trade. The government is, however, engaged in building locks and dams to produce slack water deep enough for navigation, and when all these are completed it is supposed that much freight originating in this inland region will be shipped via the Ohio.

Maryland. The coal from the fields of Maryland is all of high rank, and what is termed the Georges Creek coal is widely known as one of the best blacksmithing coals mined in the country. Shipments by rail, other than for railroad fuel, were made to seventeen states and to New England and amounted to nearly 1,900,000 tons, or 45 per cent of the output. Twenty per cent of the coal was used in Maryland and the District of Columbia.

The largest shipments were made to New England (600,000 tons), New York (567,000 tons), and Pennsylvania (506,000). About 10,000 tons of Maryland coal were used on the Pacific coast in California and Washington, and Maryland coal was used in several states in the Mississippi Valley. More than 1,000,000 tons reached tidewater at Baltimore and New York for foreign export, for use as bunker fuel, and for shipment by water to ports in New England states (25 per cent of the total). Only 387,000 tons, or 10 per cent of the output, was used for railroad fuel in 1915.

CHAPTER X

SOUTHEASTERN UNITED STATES

1. SOILS OF THE ATLANTIC AND GULF COASTAL PLAINS[1]

The soils of this province are highly differentiated and pre-eminently special-purpose soils adapted in general to highly specialized industries requiring the most intensive and expensive methods of cultivation. For the most part, the soils are light in texture and admirably adapted to early spring vegetables of various sorts. They extend through a range of climate from the subtropical immediately along the Gulf Coast to that of the latitude of New York, and have the advantage, at least when trucking is concerned, of low elevation and a nearly level surface. They are likewise favored in their proximity to the ocean and Gulf, which insures a warmer and more equable winter and spring climate than is found in other parts of the eastern half of the United States. For these reasons they have a monopoly of the markets of a very large part of the country for fresh vegetables and fruits for six months of the year or from about January 1 to July 1. On account of the great range in latitude—over a thousand miles in actual distance—and the rather slow advance of spring northward, as well as the difference in time of maturity of crops on the different grades of soil, a constant daily supply of fresh perishable vegetables and fruits is poured into the northern markets during the first half of the year. After this period, the season has advanced to a point where the supply is drawn in a similar progressive manner from the various types of soil, mainly of the Glacial soil provinces.

An idea of this progressive movement of the sources of supply of vegetables, due both to the advance of the season from south to

[1] Adapted from Milton Whitney, "The Use of Soils East of the Great Plains Region," United States Department of Agriculture, *Bureau of Soils*, *Bulletin 78*, pp. 15–17.

north and to the influence of soil texture, is given in the following table:

TABLE XXXI

MARKET PERIODS FOR FRESH VEGETABLES FOR THE SIX MONTHS, JANUARY TO JUNE, AND THE RELATIVE ORDER OF THE SUPPLY FROM LOCALITIES AND FROM DIFFERENT TYPES OF SOIL IN EACH LOCALITY

Locality	First Period	Second Period	Third Period	Fourth Period	Fifth Period	Sixth Period
Long Island..........	......	....	....	....	....	Sand
Maryland and Delaware	......	....	....	....	Sand	Fine sand
Virginia...............	......	....	....	Sand	Fine sand	Sandy loam
North Carolina........	......	....	Sand	Fine sand	Sandy loam	Fine sandy loam
South Carolina........	......	Sand	Fine sand	Sandy loam	Fine sandy loam	Loam
Georgia and Florida....	Sand	Fine sand	Sandy loam	Fine sandy loam	Loam	Silt loam

Each of the localities named can in normal seasons count on from two to three weeks advance in crop maturity over the locality north, and this is the period in which they can market their crops at the greatest profit. Furthermore, there is about the same interval of two or three weeks in the time of maturity of crops on the several grades of soil. The very earliest crops of vegetables come from the light, porous, well-drained, warm, dry sands. The yields from such very early soils are light; the quality of the vegetables is not as a rule the best; they are very perishable and do not stand transportation well. They usually bring high prices, however, because of the great demand and the limited supply on the markets.

The crop from the fine sand maturing about two weeks later gives a larger yield of better quality in every way, which compensates for the lower market price and for the competition from the more sandy soils of the next northern locality. Georgia, for example, cannot compete in the northern markets with truck grown on her heavier soils, simply because at the time it matures there is such a wide range of soils in more northern localities rushing vegetables over an ever-decreasing length of haul to the great markets.

The conditions with respect to the soils of Texas and Louisiana are somewhat different in that they can continue for a longer time to supply the great markets of the Middle West, including Chicago, St. Louis, Kansas City, Omaha, St. Paul, and Minneapolis, as there

is less competition from more northern localities, and of soil types a wider textural range can be used for early vegetables than can profitably be used in the more eastern and northern parts of the province.

While the general character of the soils of this province, their variation and extent north and south, adapt them, as has been said, pre-eminently to early trucking and fruit industries, they also have an important place in general agriculture, particularly in the production of cotton, sugar cane, rice, tobacco, and corn.

2. THE CHESAPEAKE BAY SECTION OF THE COASTAL PLAIN[1]

The coastal plain in Maryland and Delaware consists of two peninsulas. The first lies between the Lower Potomac River and Chesapeake Bay and locally is called the Western Shore. The second lies between Chesapeake and Delaware bays and includes that part of Maryland known as the Eastern Shore and the state of Delaware.

In this part of the Coastal Plain there are to be found broad fields of corn and tobacco, of wheat also, with fields of strawberries and sweet potatoes in the warm loamy areas. In the vicinity of Baltimore the area of the single fields of the general crops becomes smaller, and the various special crops included under the general term "truck" become more prominent. Tomatoes, sweet corn, peas for canneries and market, with all the different crops that contribute to the supply of the city dweller, are found in more abundance as the hauling distance becomes less. On the Western Shore the distance from the city at which truck-growing is profitable is in a general way found to be closely related to the distance easily covered by wagon hauling in marketing the produce. Such produce as melons which are brought to the wharves in the quick-sailing boats of the bay are grown at a much greater distance, and the staple canning crop (the tomato) is extensively grown on the Eastern Shore and shipped to the city by steamer.

The Eastern Shore, as a whole, is much more of a small fruit or truck region than the Western Shore, for the presence of good railroad transportation to the northern markets, in addition to the steam

[1] Adapted from *Report of the Conservation Commission of Maryland for 1908–1909*, pp. 94–97.

and sailing vessels assure the grower probability of prompt marketing. The water-carried produce usually goes to Baltimore; the railroad transportation is mostly to the cities farther north (Philadelphia and New York). The commission merchants of these cities send their buyers into the truck and especially the fruit regions of the state, and buy the crops of the growers at the farm in many instances. This is quite commonly done upon the Eastern Shore, and in the apple area of the western part of the state, and is of benefit to the grower in that he has his market come to his goods instead of having to send the goods to the market. The level nature of the Coastal Zone, and the deep rivers penetrating the land far back from the bay, assist materially in the development of the region as a truck and fruit section.

Of the truck crops, tomatoes lead in acreage and yield, with sweet corn second. Cabbage and melons are next in importance, but the method of recording the crop is quite different in the two groups. The first group, tomatoes and corn, are recorded in bushels; the second, by the individual unit, head of cabbage or single melon. Peas and beans are quite important as truck crops, but just what proportion of the yield should be credited to the truck and which to the canning list is difficult to determine. It is quite possible that any given load of produce might be raised as a truck crop, but through the various channels of trade finally reach the consumer as canned goods.

Strawberries may be discussed as a truck crop more conveniently than as a fruit, since it is also a canning crop. The chief strawberry areas are on the sandy soil of the Coastal Zone. The crop from the Eastern Shore is delivered to the northern cities, Philadelphia and beyond, while the Western Shore berries more largely supply Baltimore and Washington and Pittsburgh. This is the direct relation to the lines of communication established in the respective areas. The markets are in general supplied from the nearest source of straight shipment, as every handling adds to the cost of transportation, and to the risk of loss to the grower. Together these add to the price which the consumer pays for his berries under normal conditions.

Canning crops. The canning industry is one of the most important branches or adjuncts of Maryland agriculture. The farmer in the Coastal Zone, by his contracts for tomatoes, knows his possible

income in advance, and does not have to seek an uncertain market. The contracting feature does not assume so prominent a factor in regard to the pea and corn canning, but in each of these there is a nearby market assured the producer who supplies the canning factory. The chief corn-canning area is in the central Midland Zone; the other two crops, tomatoes and peas, are characteristic of the warmer soils of the Coastal Zone.

Baltimore being a market center draws upon distant as well as local sources of supply. This is noticeable in the canning industry. Peaches form an important part of the year's output from the city factories, the fruit being either consigned to the canneries, or bought in the open market. Strawberries are not regularly canned to an important degree, but at times of glutted markets they are so treated. A modification of ordinary canning is found in the preparation of fruit juices for use in summer drinks. Much of the strawberry fruit juice so used is secured in the Baltimore markets through the canning factories.

3. SOILS OF THE PIEDMONT PLATEAU[1]

Lying between the Atlantic Coastal Plain and the Appalachian Mountains and extending from the Hudson River to east-central Alabama is an area of gently rolling to hilly country known as the Piedmont Plateau, in which the soils are derived directly from the disintegration in place of igneous and metamorphic rocks. On the Atlantic side of the plateau it is closely defined by the "fall line" of the rivers where they flow over the eastern edges of the consolidated rocks into the unconsolidated material of the Coastal Plains, as seen, for example, at Baltimore, Washington, Richmond, Columbus, and Augusta, but on the northwestern side the boundary is not sharp, although recognizable. In its northern extension the Piedmont Plateau is quite narrow, but broadens toward the south, attaining its greatest width in North Carolina.

The surface features are those of a broad, rolling plain that has been deeply cut by an intricate system of small streams, whose valley walls are rounded and covered with soil, although many small gorges and rocky areas occur. The altitude varies from about 300 feet to more than 1,000 feet above sea-level.

[1] Adapted from Milton Whitney, *Bureau of Soils*, *Bulletin 78*, p. 73.

The extreme northern part of the Piedmont region, in New Jersey, has been glaciated, but elsewhere the soils are purely residual in origin and have been derived almost exclusively from the weathering of igneous and metamorphic rocks. The chief exception is the detached areas of sandstone and shales of Triassic age. Marked diferences in the character of the rock and the method of formation have given rise to a number of soil types.

The northern portion of the Piedmont, north of an irregular line running in a general diagonal direction across northern Virginia, being narrow, has been subjected to the greatest erosion, as the drainage courses have been steeper. As a result the present level of the land surface is considerably lower than the southern Piedmont. The open season is shorter—about three months—and erosion has so nearly kept pace with rock disintegration that the soil cover is relatively shallow and the rocks as a rule are not far below the surface of the ground. In the southern Piedmont over most of the area the rocks have disintegrated to a depth of 50 feet or more.

4. GEOGRAPHIC DIVISIONS OF VIRGINIA[1]

Five distinct geographic divisions can be recognized in Virginia, each of which has a general northeast and southwest direction, as fixed by the Atlantic Coast line on the east, and the Appalachian Mountain system on the west.

Natural Divisions	Area in Square Miles
1. Tidewater	11,000
2. Piedmont	18,000
3. Blue Ridge	2,500
4. Valley	5,000
5. Appalachian	5,400

These divisions succeed each other in parallel order, and are characterized by a general increase in elevation from the sea westward.

Tidewater. As the name would indicate, this is that portion of Virginia territory which constitutes a part of the Atlantic Coastal Plain. The western boundary is marked by that line of sudden

[1] Adapted from G. T. Surface, "Geography of Virginia," *Bulletin of the Geographical Society of Philadelphia*, October, 1907, pp. 211–60.

topographic change known as the "fall line," where the streams emerge from the hard crystalline rocks of Piedmont, on to the soft sedimentary deposits of the Coastal Plain. The great number of bays and estuaries are of comparatively recent origin, having been formed by the gradual subsidence of the Coastal Plain region, by which the rivers are drowned in their lower course through the transgression of the ocean. The Susquehanna River formerly entered the ocean east of Cape Henry, and the Potomac, James, York, and Rappahannock were its important tributaries. The continued depression converted the lower Susquehanna Valley into the Chesapeake Bay, and embayed the mouths of the lower tributaries, making them tidal streams. The effect was to make all of the important streams navigable in the Coastal Plain part of their course, and it gave to the state in the formation of Hampton Roads (estuary at the mouth of the James River) the finest American harbor.

The elevation increases from sea-level to 150–300 feet on the western border. From the surface configuration the land is commonly designated as *first* and *second bottom*, and the *ridge country*. The *first bottom*, where protected from the tide, is very productive. It is in this portion that most of the swamp and marsh lands occur, all of which are covered with a variety of swamp and marsh grasses, which are partially utilized for grazing. Wherever this has been reclaimed it is exceedingly productive, Dismal Swamp being the most notable example. No survey or special study has been made of these wild lands, but there is no doubt but that hundreds of square miles could be reclaimed at a cost which would leave a wide margin of profit.

The *second bottom* is also alluvial, and is the most valuable part of Tidewater. The subsoil is a dark red or yellow clay, with a moderate mixture of sand. The surface soils consist of sandy loams, which vary in color and consistency according to the mineral and vegetable matter predominating. The *ridge country* has an elevation of 90–300 feet above sea-level. The soil is a light sand, easily eroded, and intractable to most methods of improvement. This section involves one of the most important economic problems in the state. Calcareous marls have proved very beneficial, and it is believed by some fertilizer authorities that most of the area can be brought into a state of at least fair productivity.

The soil of the Coastal Plain is universally sandy or a sandy loam, and, with a limited rainfall, or cold climate, would be of little economic value. Having an adequate rainfall and a long growing season, it becomes ideally adapted to the profitable industry of trucking, and holds first rank in this line of production. The average growing season is from seven to seven and one-half month's duration. The winters are short and mild; the snowfall light; and the freezing never extreme or protracted. The summer's heat is so tempered by the sea breezes as to seldom become oppressive.

Piedmont. The "fall line," previously mentioned, which marks the western boundary of the Coastal Plain, is the eastern boundary of Piedmont. The Piedmont area consists for the most part of crystalline rocks and varies in elevation from 150–300 feet on the east, to 700–1,200 feet along the Blue Ridge border. Streams cross it almost at right angles, in a general southeastern direction.

Blue Ridge. This stands out as the most conspicuous and persistent of the natural divisions in the state, being a continuous barrier from the Maryland boundary to the North Carolina boundary, excepting an occasional water or wind gap. With an elevation of 1,460 feet at Harper's Ferry, where the Potomac River breaks through the Blue Ridge, it increases southwestward to 4,001 feet in Bedford County (Peaks of Otter), and reaches a maximum of 5,700 feet in Mount Rogers, Grayson County, Virginia. It is three to twenty miles in width. The southern portion expands into a fan-like plateau, which is the watershed for the waters flowing into the Atlantic Ocean and the Gulf of Mexico.

The Blue Ridge, together with that part of Piedmont adjacent to it, is peculiarly adapted to apple culture. The most successful growers plant their orchards on the mountains, because the valleys are not only more subject to frost, but the winter temperature is lower than for the mountain, up to a greater elevation than is represented by most of the mountains of Virginia.

The Valley. This is a continuation of the Great Valley of east Tennessee, and becomes the Cumberland Valley in Maryland and Pennsylvania, the Kittatinny Valley of New Jersey, and the Newburg part of the Hudson River Valley in New York. The Valley region is that which lies between the western base of the Blue Ridge and the eastern base of the Alleghany Front. In Virginia it is

15–40 miles in width, and 230 miles in length. For the purposes of convenience we may recognize three general sections: the northern, or Shenandoah Valley section; the central, embracing that region between the headwaters of the Shenandoah and the Holston rivers, which is cut by the transverse valleys of the James, Roanoke, and New rivers; and the southern section, that part drained by the Holston River.

Viewed topographically, it is a broad, gently rolling plain, with the floor dissected by minor drainage systems. The elevation increases southwestward and westward, being 242 feet above tide at the mouth of the Shenandoah, and 1,687 feet where the Holston River crosses the state line. The soil of the Valley is prevailingly limestone, and it is by far the most productive of the natural divisions.

The position of the Valley topographically marks it out as a natural transportation route from Birmingham and Chattanooga at the south to Baltimore, Philadelphia, and New York at the north.

Virginia as a whole consumes more cereals than it produces; but the Valley produces a surplus of wheat and corn, the wheat surplus being the larger. Of the total wheat production in the state more than one-half is grown in the Valley. The adequate and well-distributed water-power is utilized in manufacturing flour. As a result of the special attention given to the live-stock industry throughout the Valley, the cultivation of corn is general. It is naturally somewhat concentrated on the alluvial bottom lands, but not to the extent practised in the other divisions. Since farming has been more profitable in the Valley than in other portions of the state, the methods of cultivation are proportionately more advanced.

Appalachia. This is the most irregular of the natural divisions both in boundary and physical features. It consists of a series of ridges of northeast-southwest direction, alternating with narrow trough-like valleys. In Virginia this irregular belt is 260 miles in length and 10 to 50 miles in width. The soils of the upper slopes of the ridges are usually sandy and sterile, being derived from heavy siliceous sandstones and conglomerates. Those of the lower slopes are fairly productive as they are formed from softer shales. The narrow valleys are made up of sandy calcareous alluvium, with often a strong impregnation of iron, and are productive. Cultivation is concentrated on the valleys and lowlands. Because of the very

broken topography common to the region, it is best adapted to grazing. More virgin forests survive in this belt than in any other part of the state, because of its inaccessibility. With the superior water-power, which abounds throughout the region, the manufacture of hardwood products should become an important industry. This is the most productive region of the state in mineral resources.

5. THE COTTON BELT[1]

Cotton ranks second in value among the crops of the United States and occupies fifth place in acreage. It is the most important commercial crop of this country, and within the "Cotton Belt" has a value exceeding that of all other crops combined. The area of the Cotton Belt is about 300,000,000 acres, of which, in 1910, 65 per cent was in farms, 30 per cent was improved land, 22 per cent was in crops, and 11 per cent was in cotton.

About two-thirds of the Cotton Belt consists of a broad coastal plain composed principally of sedimentary material, bordering and largely derived from two ancient and much eroded mountain masses, the Appalachian Highlands (including the Piedmont) in the East and the Ozark Highlands in the West. From these highland areas rivers radiate across the Coastal Plain, bordered, especially along their lower courses, by swampy flood plains in many places several miles in width; and in the broad depression between these two highlands the Mississippi River flows southward, dividing the Cotton Belt into an eastern and a western section approximately equal in area, in acreage of improved land, and in production of cotton. Beyond the boundary of the Coastal Plain the Cotton Belt includes northern and western marginal regions, comprising a portion of the Piedmont Plateau and of the valleys associated with the Cumberland Plateau and Blue Ridge Mountains in the East, together with the valleys of the southern Ozarks (Ouachita and Boston Mountains) and a portion of the prairies and great plains of Texas and Oklahoma in the West.

[1] Adapted from O. C. Stine and O. E. Baker, "Cotton," *Atlas of American Agriculture*, United States Department of Agriculture, Office of Farm Management, Part V, Sec. A, pp. 8–28. Mr. Stine is assistant in farm economics, Office of Farm Management.

The northern limit of commercial cotton production in the United States follows closely the average summer temperature line of 77°, or that of 70° for the growing season, and very little cotton is grown where the average season between killing frosts is less than 200 days. The western limit is approximately the line of 23 inches average annual precipitation. Very little cotton is grown along the Gulf Coast east of Galveston and practically none in southern Florida, owing partly to the swampy or sandy soils and partly to the greater autumn rainfall which interferes with picking and injures the quality of the lint. The areas of greater production are regions of more fertile soils—the Piedmont Plateau and Upper Coastal Plain (which are separated by the less fertile belt of Sand Hills), the Black Prairie of Alabama and Mississippi, the Yazoo-Mississippi Delta, the Red River Valley, and, most important of all, the Black Waxy Prairies of Texas. In the first two regions the use of fertilizers has greatly increased the productivity of the soil. Cotton is a new crop in the southwest. In 1909 there were only 324 acres in California and 19 in Arizona, but by 1916 the area had increased to 98,000 acres in the Imperial Valley, including both the California and Mexican portions, and 15,000 acres in Arizona, all grown under irrigation.

Cotton is the great crop of the South. It occupies the best land and is the chief source of the farmer's income. Through the center of the Cotton Belt, cotton occupies one-half or more of the cropped land and is the most important crop produced for market. Although cotton requires labor throughout practically the entire season, the distribution of that labor is such that other crops may be cultivated to some extent without reducing the acreage of cotton, and consequently a great diversity of crops for home consumption is produced in the Cotton Belt. Corn is the most important of these crops, and in many regions the acreage in corn is equal to the acreage in cotton. Oats, wheat, rye, cowpeas, sweet potatoes, Irish potatoes, sorghum, garden vegetables, and fruits are produced in considerable quantities in some parts of the South. Although there is this diversity of crops, in many cases not enough food is grown by farmers for home use or to feed the live stock, which on the small farms usually consists of a work animal, a cow, some swine, and poultry. Though there is land available for the production of food and forage crops and though diversification in commercial crops is being constantly urged upon

the South, the acreage devoted to all of these crops, excepting corn, is relatively small; and consequently the South imports from the North every year large quantities of foodstuffs and grain for feed, which is distributed not only to the city population but also to the cotton growers on the farms.

Natural and economic forces have made the South peculiarly dependent upon cotton. Cotton may be grown only under certain climatic conditions, which restrict its production in the United States to the southern states, whereas grain and forage crops, which are grown to some extent in these states, are grown in other parts of the United States under climatic conditions as favorable or even more favorable for their production. Since cotton will grow on practically all well-drained soils, is drought resistant, and yields well on light sandy soils to which fertilizers have been applied, it is better suited to many of the soils of the South than are the other staple crops. Furthermore, the South has a denser agricultural population and cheaper labor than other parts of the United States, both of which circumstances favor the production of cotton, as it requires a large amount of hand labor and yields high returns per acre. Since cotton can be produced cheaply only in the South, whereas other staple crops can be produced as cheaply or more cheaply elsewhere, it is more profitable with normal prices to produce cotton in most parts of the South than to produce other crops and live stock for market, except in so far as their production with the cotton crop results in better and more efficient use of the labor and capital on the farm.

The character of the labor supply and the large amount of hand labor used in the production of cotton have developed systems of managing the farm peculiar to the South.

From the time when cotton became a commercial crop in the South until the Civil War, it was commonly grown under the plantation system. Strictly speaking, the term "plantation" was applied to a large farm operated under one management with slave labor frequently directed by an overseer. The planter exercised supervision over the growing of crops through the overseer and handled most of the business transactions himself. After the slaves were freed, the "cropper" system was established, and the "plantation" may now be defined as a large tract of farm land operated under one management by wage hands and croppers. Under the cropper

system there is much less supervision by the owner or manager than was necessary with slave labor and less than is necessary to operate the plantation with wage hands. The planter does not always have an overseer, although on the farms most commonly recognized as plantations one is usually employed. The term "plantation" is often used colloquially, however, to designate any large farm employing a considerable amount of labor.

Plantations as defined by the census are most numerous in the older cotton-growing states. Texas was a part of the United States for only a few years before the Civil War, so that slavery and the plantation system did not have time to develop there to the extent that it did in the states east of Texas, and therefore the plantations of today are found only in the eastern part of the state. Oklahoma has no plantations, as it has been settled in recent years, too late for the system to become established.

Plantations are the largest in Texas and Louisiana. The large plantations have a high percentage of unimproved land, most of which is under the control of the owner. The croppers on the plantation rent mostly the improved land, leaving the unimproved in the care of the owner, who utilizes it for supplying fuel and to some extent for the grazing of the live stock belonging to the plantation.

6. THE BLACK BELT OF ALABAMA[1]

To speak of the "Old South" is at once to suggest a very definite type of civilization. There has been no more distinctive human product of American soil than the culture of the "Cotton Kingdom" of ante-bellum days. Two generations from the declaration of democratic faith saw flourishing a caste system, rooted in the institution of slavery of which the spread was largely conditioned by geographic factors—the fertile soils and warm temperate climate of the South.

It was a short-lived civilization this, with its social ideals expressed in the ownership of "a mansion, a cotton plantation, and a hundred slaves," but its relics still remain. If one would see them before they are swept away by the hand of progress let him for choice go

[1] Taken from Herdman F. Cleland, "The Black Belt of Alabama," *The Geographical Review*, December, 1920, pp. 375–87. Mr. Cleland is professor of geology at Williams College.

to Alabama and in Alabama to the Black Belt. Ask almost any Alabaman where the best ante-bellum architecture of the state is to be found and the answer will surely be, "In the Black Belt." Ask in what part of the state the people are most cultured and most highly educated; where the traditions and prejudices of the Old South are strongest, and it will be, "In the Black Belt." Ask for a town typical of the Old South, and Greensboro will frequently be mentioned; and unspoiled, Greensboro is well worth a visit.

A brief description of this town of about 2,000 inhabitants, of which the greater portion are negroes, will serve as a starting-place from which to discuss the geographic influences which shaped the civilization of this interesting region. Moreover, Greensboro is especially favorable for such a study because, like most towns of the Black Belt, it is not situated on a waterway, and the complex factors which arise from such a situation are lacking.

The "Mansion" of the Cotton Planter. About a mile from the railroad station at a turn in the road is seen the first "mansion" or "big house," as the negroes term the home of the landowner, whether it be large or small. It is almost hidden by a tangle of vines and shrubbery and by the great trees which shade it. A more perfect setting for the most romantic stories of Thomas Nelson Page would be hard to find. The dignified simplicity of the tall Ionic columns that support the pediment to form the porch, the nearly perfect proportions of the house gleaming among the green of the great oaks give an impression of culture and romance.

Further on down the street other ante-bellum houses are seen, all in spacious grounds, but most of them surrounded by unkept lawns and decrepit fences. No two houses are alike; each has its own individuality, and most of them have great charm. In all of them the columns are two stories high; but some are square, some round and smooth, some round and fluted, some hexagonal, some thick, and some slender. All the houses have either a gallery running their full width or a balcony over the front door. Some, however, are not of the colonial type but show the influence of the French architecture so characteristic of old New Orleans. As a rule, a wide hall, with a high ceiling, extends through each house on each side of which are two rooms 20 by 20 feet. In ante-bellum times the kitchen was entirely separate from the main building; but this custom was

abandoned after the freeing of the slaves, and the kitchens are now attached to the houses.

In construction and appurtenances the mansion is typical of the civilization that produced it. In a town of the Black Belt not far from Greensboro is a house perhaps as large and fine as any in this town—a house which cost the owner, according to his boast, not more than $450. The bricks for the foundation and fireplaces were made and laid by his own slaves; the lumber came from the trees of his own woodland and was cut and sawed by his slaves; and the house was built by negro carpenters who belonged to him. Only the window glass and hardware, which his blacks could not make, were purchased. It is difficult to estimate the cost of the ante-bellum houses which were built largely by slave labor, because of the great variation in the cost of interior decorations. From the data available it seems probable that a house worth $25,000, if built by contract in 1914, probably cost about $3,000 or $4,000 under ante-bellum conditions.

The Poorer Quarters and Negro Cabins. There is an erroneous impression in the North, and in the South for that matter, that most of the white population of the South before the Civil War were slave-owners, whereas the truth is that only about 40 per cent of the families owned slaves. The poor of the white population did not own slaves, and their houses were as cheap and unsightly as those of people in similar circumstances today. Consequently anyone who visits Greensboro expecting to find a street lined with stately dwellings will be greatly disappointed, for there are more unattractive than attractive houses. Nevertheless, the proportion of old dignified houses is sufficiently large to make the streets unusually interesting, and is greater perhaps than in any other town in the South. The fact that the mansions were surrounded by extensive grounds should not be forgotten if a true conception of a Black Belt town is to be gained. The following figures, taken at random, are the areas of the plots of ground surrounding the planters' homes in Greensboro: 140, 60, 30, 6, and 5 acres.

The black servants of the planters lived either in a restricted section of the town or in cabins scattered here and there over the plantations. These cabins are nearly all alike, containing one or two rooms and having a brick, or stick-and-mud, chimney built on

the outside. In the country districts one sees many negro cabins and occasionally an overseer's house but seldom the home of a planter. Indeed the picture that comes to one's mind after traveling over the Black Belt is that of a fertile, gently rolling prairie with negro cabins standing in the open fields and not even a tree or shrub to furnish shade or add a touch of beauty.

Main Street and the Old Market. There is little to be said about the business street of Greensboro. It is no better and no worse than the "main street" of the average American village or town. However, it is of interest to the Northerner on a Saturday when the negroes come to town to do their trading and as compared with the whites number perhaps 25 to 1. Although most of the buildings have been erected since the close of the Civil War, the street was probably even less inspiring in "the old time" than now. There is one building, however, that gives it a flavor of the Old South. It is the old market, and, although now used for other purposes and standing in a back yard, it assists one to reconstruct the life of sixty or seventy years ago. It is doubtful, though, if this market was ever an important institution in the life or economy of the village in ante-bellum days, as most of the plantations were nearly self-supporting.

The presence of the college on the edge of the village tells much of the ambitions and aspirations of the settlement. College and mansion, overseer's home and negro cabin give a picture that is typical. Let us now extend our view over the Black Belt as a whole.

What Is the Black Belt? The Black Belt, also called "Black Prairie" and "Canebrake" and "Cotton Belt," is not so named because of the large number of negroes, although it happens that the proportion of negroes to whites is 78 to 22, the highest in the state, but because of the dark color of soil which is in striking contrast to the red and yellow soils of most of the state. This strip of rich, black soil has an average width of 20–25 miles and an area in the state of about 4,300 square miles and extends in an east-west direction nearly across south central Alabama. It conforms almost exactly with the easily decomposed, impure, chalky, Cretaceous limestone (Selma chalk) which has a thickness of about 1,000 feet in the western part of the state and disappears in the east, near Montgomery. This formation dips to the south at the rate of 30–40 feet to the mile while the surface slopes at a much less rapid rate in the

same direction. The weathering of the beveled edges of this "rotten limestone" determined the width and position of the Black Belt; and the soil formed from it is a clay of exceptional fertility but somewhat difficult to work because it bakes in summer and becomes tenacious mud in winter.

Physiography of the Black Belt. Physiographically the Black Belt is a trough-shaped depression with a gently undulating surface, parts of which, "mostly remote from the rivers, are so level that the railroads have built several tangents (i.e., straight tracks) a dozen miles or more in length." In the whole region, with the exception of the river bottoms, swamps are rare, notwithstanding the clay soil.

An early writer characterized it thus: "In the uncleared parts of the canebrake one can scarcely satisfy himself that he is not standing on the low grounds of a river; the deep, alluvial-looking soil beneath his feet, the moisture-loving long moss (*Tillandsia usneoides*) above his head, together with an undergrowth of *Sabals*, *Palmettoes*, and other natives of damp soils, strengthen the illusion."

As one rides over the gently rolling surface of this region and crosses the steep-banked gullies and the bluff-bordered rivers one is impressed with the aspect of topographic youth. However, a more careful study forces one to the conclusion that the region is not only not in the youthful stage of a first cycle of erosion but that the surface is a recently raised (Pleistocene) peneplain whose thick residual soil has not yet disappeared and in which the rejuvenated streams have sunk their beds in places 60 or more feet below the surface of the plain.

Early History. The topography, soil, and climate of the Black Belt offered unique opportunities for settlement. In the second decade of last century the cession of Indian lands opened up large areas of Alabama to the westward movement. Pickett, the historian of Alabama, picturesquely describes the movement thus:

> The floodgates of Virginia, the two Carolinas, Tennessee, Kentucky, and Georgia were now hoisted, and mighty streams of emigration poured through them, spreading over the whole territory of Alabama. The ax resounded from side to side, and from corner to corner. The stately and magnificent forests fell. Log cabins sprang, as if by magic, into sight. Never, before or since, has a country been so rapidly peopled.

In the case of the Black Belt, however, when first occupied possibly 10 per cent of the surface was treeless so that the early settlers

were immediately able to raise an abundant harvest on the rich, virgin soil.

The first mail was brought to Greensboro in 1818, only forty-three years before the opening of hostilities between the North and South, but so rich was the soil and so profitable the slave labor that thirty years after this date the land had been cleared of its timber and the pioneer log cabins largely replaced by the fascinating homes of the southern planter. In fact, one of the finest ante-bellum houses was built in 1843, only twenty-five years after the settlement of the region, and near Demopolis the famous Gainswood mansion was built only fifteen years after its settlement.

The land of the Black Belt was acquired under homestead acts and by purchase in connection with these acts. A settler was allowed to "homestead" 160, 320, and 640 acres according to the changing laws of the period. Title to practically all of the land was acquired between 1819 and 1839, and, as during this period the law permitted a person to buy large tracts in addition to his homestead at prices ranging from 25 to 30 cents an acre (though it is reported that some of the land was sold by the General Land Office at public sales for as much as $50.00 per acre), many wealthy persons availed themselves of the privilege and purchased hundreds of acres. One plantation contained 11,000 acres and very few less than 1,000 acres.

The Plantations. Most of the planters of the Black Belt lived in towns—several of them situated on the northern or southern edge of the belt—and there built their big houses or mansions. The term "planter" was in common use, and the men who graduated from the University of Alabama before the Civil War and who engaged in agriculture are invariably designated as planters in the alumni catalogue of that university. Because of the extent of the estates it is not surprising to find that some of them were ten, fifteen, and even thirty miles from the planter's home. To reach his plantation the planter was obliged to travel on horseback during the greater part of the year because of the condition of the roads, which when wet were "converted into a mass of clay sufficiently soft to allow his wheels to drop down to the axle, but having a tenacity that no clay ever had."

The number of slaves owned by seven Greensboro planters about whom information was obtained was, on the average, one slave for

every ten acres; for example a planter owning 4,000 acres would have 400 slaves. If the negro family had, on the average, six children the man of the family would at this rate care for about 80 acres. Such information is, however, very untrustworthy because of the tendency on the part of the descendants of a family to give the maximum rather than the average number of slaves. The estimate that on a plantation of 2,000 acres there were, on an average, about 75 slaves including men, women, and children, seems most probable. Very few planters in the South ever owned as many as 500 slaves.

Social Relations and Culture. One indirect effect of the physical conditions which resulted from the ownership of large plantations was the development of a self-respecting landed aristocracy which, because of the large size of the estates, was relatively small. It is on this account that the knowledge of family history possessed by the older generations of the people of this region is almost uncanny. Mention the name of an old Alabaman family, and doubtless almost any of the older inhabitants can tell you not only a great deal about the family characteristics and history but also who are their "kin" by marriage, even though they had never met a member of the family.

There is an all too prevalent but unfounded belief that the presence of an inferior race in large numbers lowers the standard of the dominant race. In the Black Belt where the proportion of negroes to whites is larger than in any other part of the United States (except the black counties of the Mississippi River bottoms) and where the average wealth of the landowners is relatively high, the white people have maintained high standards of education and culture. Illiteracy among the whites amounts only to about 2 per cent; that of the negroes is about 44 per cent.

Cultural development of ante-bellum days was the same as it is the world over where rich lands have yielded wealth and the leisure that promotes a high state of civilization. Bliss Perry has expressed it by saying that with few exceptions the best literature of the world has been the work of men whose energy was not dissipated by poverty. The southern planter was patron and cultivator of the arts. The estate to which he believed himself called demanded the equipment of an education and this of the old-fashioned classical kind. The little college of Greensboro was one of many similar local institutions

in the South founded by the planters in their desire for culture and learning at a time when travel was difficult, when roads were even worse, if possible, than they are now, and there were no railroads. In this connection it should be noted that the Black Belt was settled almost exclusively by people from Virginia and the Carolinas, many of whom were from families of wealth and education.

"The Lost Cause." The loyalty for the "Lost Cause," which lingered so long in the Black Belt, was the outgrowth, directly and indirectly, of geographic influences. The most important factors were the lack of natural resources other than soil, such as coal, iron, and water-power, and indirectly the negro population. Because of these conditions there was little to attract immigrants; and, as the people were impoverished by the war, they were unable to travel. The consequence was that the deep convictions which their environment engendered were long retained. These convictions were strengthened by the inexcusable policy of reconstruction times when the organization of the Ku Klux Klan was made necessary in order that the rights of decent people might be safeguarded. It is also probable that not a little of the bitterness toward the North resulted from the poverty in which the people of the South found themselves after the war. According to the historian of Greensboro, it was not until the year 1884 that there was a semblance of building in that town.

Loyalty to the Union has come since then. For thirty-three years after the close of the Civil War no United States flag was unfurled in Greensboro; but in 1898 when the news of the destruction of the Spanish fleet by our navy at Manila reached the United States the feeling of pride broke the restraint of a third of a century, and the Stars and Stripes again floated to the breeze to celebrate the victory. The Spanish American War, the election to the presidency of Woodrow Wilson, a man born south of the Mason and Dixon line, the great world-war, and the passing away of many of those who fought and suffered in the Civil War, have combined to make of the people of the Black Belt loyal defenders of the country, though always retaining an affection for the Stars and Bars.

Recent Changes in the Black Belt. Many things have conspired to leave Greensboro nearly untouched by change. Even the railroad is a branch line and is about a mile from the town. There are

no factories to attract foreigners or laborers from other states, and few outside influences have affected its placid life since the Civil War. But now after its sleep of fifty years this Old South town is rapidly losing its isolation, and the same is true of many other towns of the region. Roads are being rapidly improved, and the omnipresent automobile is doing its share in the awakening.

Upon the death of the old planters the land is divided among their heirs or is sold, and the great estates are disappearing. Already one sees by the roadside advertisements offering sixty-acre farms for sale, and much land has been purchased in the past ten years by people from the Middle West. Before another fifty years shall have passed the land of the Black Belt will probably have been broken up into many small farms, few or none of the princely ante-bellum estates of hundreds of acres will remain, and most of the old mansions will have passed into the hands of strangers. One sometimes wishes that the English law of primogeniture were in force in this country so that these estates might be handed down intact to the first-born from generation to generation. But perhaps it is better that the new order replace the old, since a greater number of people are benefited by the breaking up of the great plantations. This will result in a greater density of population, greater wealth, better roads, and less illiteracy among the negroes.

The saddle horse of the planter has already been largely supplanted by the automobile; the old families are gradually disappearing from the towns; and in a few years the descendants of those who made the romantic civilization of the Old South will be few. The record of the past will soon be found only in courthouse documents, on the gravestones of the ill-kept cemeteries, and in material form in such ante-bellum homes as shall have escaped the ravages of fire and decay.

7. MISSISSIPPI-YAZOO FLOOD PLAIN[1]

Topography, Drainage, and Soil. The Mississippi-Yazoo flood plain, often called the Yazoo-Mississippi Delta or the Yazoo Delta, is a large elliptical section of the alluvial plain of the Lower Mississippi River in the western part of the northern half of the state of Missis-

[1] Adapted from E. N. Lowe, "Mississippi, Its Geology, Geography, Soil, and Mineral Resources," *Mississippi State Geological Survey, Bulletin No. 14*, pp. 269–75. Mr. Lowe is director of the geological survey of Mississippi.

sippi. Its northern point is just below Memphis, the southern at Vicksburg, a distance approximately of 200 miles, and its greatest width about 60 miles. It is a low-lying featureless expanse, sloping gently southward, bounded on the west by the Mississippi River and on the east by the rim of Bluff Hills, which stand abruptly above it 100 or 200 feet. The surface of this region slopes toward the gulf, the altitude at Memphis being 217 feet, that at Vicksburg 94 feet above sea-level. The area is about 8,600 square miles in extent.

While the general topography is that of a level plain, there are slight differences in elevation which have a definite relation to the drainage. The whole area is alluvium, deposited by the Mississippi and its tributaries flowing through the area. Until a few years ago these streams in flood season overflowed their channels and spread over the broad flats. Sediments brought from the higher lands by the streams were deposited, gradually building up the alluvial plain; but the coarsest and heaviest deposits were made along the borders of the streams, while the finer materials were carried out and deposited farther away from the water courses. As a result, the land built up rapidly near the streams and slowly in the interstream areas, so that the front lands are a few feet higher than the areas farther back, and gradually slope away from the river. The soils formed of the materials deposited are coarser and sandier near the streams, and finer loams and clays farther back on the lower lands.

The area is drained by a network of tortuous, sluggishly flowing streams. Besides these, numerous bayous, sloughs, and lakes, many of which are old stream channels silted up, wind about and intersect in such a way as to convert large areas into islands. With all the mileage of natural drainage channels, this flood plain or delta is poorly drained, and the greatest problem confronting that richest section of the state now is one of drainage. A large proportion of this area, including the richest soil on the continent, is rendered useless by the lack of drainage. The delta, however, has one compensation in its numerous rivers—more than a thousand miles of waters, besides its excellent system of railroads—transportation facilities unequaled elsewhere in the state.

Character and Distribution of Soils. The discussion of the topography of this region gives some intimation of the character of the soils. Popularly, they are spoken of as of two kinds—the light loam

soils near the streams, and the heavy clay or "buckshot" soils of the lower lands between the water courses. The first drain well, the latter very poorly. All the older settlements in the delta were upon the higher land along the streams, both because of convenience of transportation and immunity from overflow, as well as because this soil was more satisfactory to cultivate and more certain of crop.

Native Vegetation. The delta is pre-eminently a region of hardwood growth, and was originally heavily timbered with forests of red, white, and overcup oak, elm, ash, cypress, red, and tupelo gum, pecan, hickory, cottonwood, maple, magnolia, beech, basswood, and hackberry. The two species of gum formed more than 50 per cent of the whole. Large forests still remain, but, on account of the valuable hardwood, are being rapidly cut over and the lands prepared for cultivation.

Much of these forests have little undergrowth except blue cane, which grows in impenetrable "brakes" about the sloughs and bayous. Dwarf palmetto grows abundantly on the low areas bordering the true swamps. Creepers, as poison oak, trumpet creeper, Virginia creeper, and wild grapes frequently coil and cling to the trees of the forests, especially along the borders of openings.

Culture. Nowhere in Mississippi have ante-bellum conditions of land-holding been so nearly preserved as in the delta. The land is held in large plantations, several hundred to several thousand acres in extent, which are devoted almost entirely to cotton growing, and are worked entirely with negro labor. The land-owner, especially of the larger estates, frequently does not live upon the plantation (in this respect differing from the ante-bellum land-owner), but in some neighboring town or city, the immediate affairs of the plantation being left in the hands of a manager. The work of the negro tenants is under the supervision of the manager. Each place has its commissary store from which the negroes are supplied, a deed of trust being given upon their crops for the year's supplies advanced.

The usual spectacle presented on these plantations is that of two or three white families surrounded by two or three hundred negroes, though the automobile has, in a large measure, relieved the social isolation of the delta planter. The negro is naturally gregarious in instinct, and is never so happy as when massed together in large numbers as on the delta plantations. The management is

necessarily firm, but strange to say, there seems to be really less difficulty in controlling the labor satisfactorily in large numbers than in smaller numbers, as on the hill farms.

Since the first settlement of the delta, the sole crop has been cotton, the corn grown being always less than that consumed on the plantations. Occasional sporadic efforts have been made in other directions, but only by way of limited experimentation. For a number of years long staple cotton has been largely grown, the soil being especially adapted to it. This has added greatly to the wealth of the delta, since the price is much higher than that of the short staple varieties.

The system of culture so far produced is very exhausting, all being taken off and nothing put back upon the soil. The constant growing of the same crop is beginning to tell upon the lighter soils and the time is not far distant when the process must be changed. We are not yet in position to know the extent to which the boll weevil will affect the cotton planting in the delta, but it would certainly be the part of prudence for the planters to begin to make provision for the contingency by growing at home everything that can be grown for consumption upon the place. Every year a large proportion of the proceeds of the plantation goes to buy from the northern markets supplies for the tenants, feed for the animals and even the mules, and every piece of machinery used on the place, nearly all of which can be produced on the place with little expense. Why buy up-country corn and oats when the soil of the delta plantation will yield both in great abundance with little expense? Why buy meat from the packing-houses, when hogs can be raised at small expense in the delta? Why buy Missouri mules at $200 a head when just as good can be raised at $20 apiece?

8. THE SOUTHERN LONG-LEAF PINE BELT[1]

A generation ago the geographic student read that, for the most part, the southern Yellow Pine Belt was a dense forest with a relatively small lumber production. The student of today learns that this belt is the main lumber-producing region east of the Rocky

[1] Adapted from F. V. Emerson, *Geographical Review*, February, 1919, pp. 81–90. Mr. Emerson was, until his death in 1920, professor of geology at Louisiana State University.

Mountains. Twenty years hence, when most of the timber shall have been cut, what will the future student read? This is a geographic question, for geography is concerned with the relations between man on the one hand and soils, climate, and other earth factors on the other; an economic question, for here will be an area greater than that of Texas which must somehow find its place in our economic development; a social question, for its solution will determine whether man in this belt shall live well or poorly, on large plantations or small farms, in towns or in the country. Furthermore, it is quite possible that the future population of the cut-over pine lands will be a more or less distinct political unit, for politics is often markedly affected by earth factors.

A consideration of the problem falls into two main divisions: one concerned with the soils and climate which condition the belt, and the other with the two economic-geographic results, namely (1) the present lumber industry, and (2) the future development of the cut-over pine lands.

This belt is often called the Yellow Pine Belt, since most of the southern pines are comprised in this lumberman's trade term. The long-leaf pine is so called from its clusters of long needle-like leaves in contrast to the short-leaf pine, which has short needles. A drive through the virgin long-leaf pine forest will long be remembered. The stately trunks rise 40–60 feet and then spread out their dense foliage, which joins above like the arches of a cathedral. There is little or no undergrowth, and the view fades into a maze of the column-like tree trunks. This variety of pine is a native of the South, with its warm, moist climate. It grows on sandy soils which are relatively infertile, a characteristic shown by the term "pine barrens," which is often applied to these lands. The Long-Leaf Pine Belt stretches from southeastern Virginia in a long sweep to Texas and includes an estimated area of 250,000,000 acres, an area nearly five times as large as that of New York. At present from 5,000,000 to 10,000,000 acres are being cut over each year, an area about the size of Massachusetts.

The Lumbering Industry. There has been for many decades a considerable lumbering industry in this belt along railroads and rivers, and the timber is pretty well stripped back from the main lines of transportation. Formerly the mills were small, and cutting

was limited to distances which could be covered by ox-team and mule-team transportation. Back of these cuttings was an almost unbroken pine forest. Twenty to thirty years ago, when the northern forests were approaching exhaustion, professional lumbermen bought these virgin pine forests at nominal prices. We have seen that the transportation problem of getting the logs to mills and then getting the lumber to market had limited local development, for local companies possessed small capital. To locate large mills on a railroad and then haul the logs ten or fifteen miles or more required well-built tram roads, which are expensive. The large-scale exploitation of the pine timber, therefore, passed to companies possessed of ample capital, and the lumbering industry in this belt, like so many other industries, is largely in the hands of capitalists and strong companies, many holdings including tens of thousands of acres. Fortunately the level and rolling surface offers few obstacles, and thousands of miles of well-built railroads now traverse these forests. Most of these railroads are of standard gauge. After the timber has been cut, the owners are reluctant to abandon the expensive railroads and so maintain some train service, with the hope that the country will develop and make the roads profitable or that some trunk line will buy them as feeders. Many of the abandoned tram roads are now used as public highways, and they will be an important factor in the development of cut-over lands.

Lumbering in this belt employs about a quarter of a million men, and nearly a million people are dependent on the industry. The lumber towns are, as a rule, up to date, with electric lights, city water, often gas, and sometimes paved streets. The schools are always good. These towns are necessarily more or less temporary, yet the modern method of extending tram roads for considerable distances insures the town's existence for ten to twenty years until the timber of the tributary territory is cut. They are far from resembling the "shack" towns which grow up around small mills. These mill towns are serving and will serve as nuclei for the rural population which occupies the cut-over lands as the timber is removed.

The Cut-Over Lands. The common practice is to remove not only the timber but also the smaller trees which can be used for poles and paper pulp, for, while the expensive tram road is in operation it is to the lumberman's advantage to get out all the timber he can,

even if the profit on some of it is low. Almost invariably forest fires sweep through the timber wreckage of cut-over lands, and much of the cut-over country is dismal indeed. The pine almost everywhere implies relatively infertile sandy soils—relatively, let it be said, for some sandy soils have been made very productive. In many instances the farmer on cut-over lands must first build up his soil, which is usually deficient in nitrogen and humus and often phosphorus. These large areas of cut-over lands are thrown on to the market faster than they can be absorbed. The states are vitally interested, for, with the cutting of the timber, land values slump and taxes are decreased; it is therefore very important for the state that these lands be put to use. The railroads are apprehensive that freight traffic will all but disappear when the lumber is gone; the owners are obviously interested in disposing of these lands; the nation is interested in them as a possible substitute for the public lands of the West. The question of utilizing the cut-over pine lands is one of the most important faced by the South today. The three most feasible projects of utilization are reforestation, agriculture, and live-stock raising.

Reforestation. It is estimated that not far from 20 per cent of the cut-over pine lands should not be cultivated until our population density reaches that of western Europe, and perhaps not then. Some lands are so hilly that active erosion sets in when they are cleared. Other lands are flat, so that drainage is necessary, an expense which the land values will not justify for many years. Still other areas have deep sandy soils of such low natural productivity that most of plant foods must be furnished them. With the present rate of absorption large areas will remain untilled for one, two, or more generations, and in that time reforestation would be profitable. In this connection, two questions must be considered: Is reforestation possible? and Is it commercially feasible? For many years lumbermen have believed that reforestation on a commercial scale is not possible because the usual second growth is not pine saplings, as one might expect it to be, but "scrub oak," a name which fails to indicate the average poor opinion of this shrub which refuses to grow into a tree, which has a trunk so crooked as to be useless even for fence posts, but which quickly occupies the soil in dense thickets. The Hardtner family of Urania, Louisiana, who are extensive lumber-

men, have proved the possibility of natural reforestation and have made that town classic in forestry. Through their experiments we now know positively that the long-leaf pine seedlings have two enemies, both of which can be abated. Running fires will kill the young seedlings, and these fires are almost annual occurrences during the dry spells. Again, the razor-back hog, which roams far and wide, is very fond of long-leaf pine seedlings and roots, and he will root up an almost incredibly large area in getting his day's food. It has been shown that, by keeping down fires and fencing out the hogs, a pine forest can soon be started and that after a few years' growth it will withstand both hogs and ordinary fires.

The average lumberman, however, is after his "clean-up" and, like the rest of us, is not much interested in a crop that will not mature for twenty years or more, so that reforestation will probably be carried on mainly by well-organized corporations which have an eye to future dividends. As an instance of this, the Great Southern Lumber Company of Bogalusa, Louisiana, is operating pulp mills to utilize the smaller logs. Within twenty years their present stand of virgin timber will have been cut, and they are starting reforestation with a view of providing timber against that time.

Agriculture. Conditioning factors of agriculture are soil, climate, transportation, and markets—the latter two factors being fairly favorable to the cut-over pine lands. The soils are not productive, else the westward-moving emigrants would not for the most part have passed around this belt. They yield somewhat scant crops of cotton, corn, and wheat unless they are quickened with commercial fertilizers. But, as if nature wished to compensate for a shortage of nitrogen and humus, these soils produce heavy growths of cowpeas, velvet beans, and peanuts—all legumes which capture nitrogen from the air and leave it in the soil, besides furnishing the best of feed. The pine soils are "warm," they drain readily, and are therefore excellent truck soils. The strawberry growers of Tangipahoa Parish in eastern Louisiana ship about $3,000,000 worth of berries annually. Their lands are rolling to level, with typical sandy soils underlain by impervious clay. Many of the growers are Italians, who, with characteristic thrift and industry, have drained and built up the soils, until they have acre values of $100 or more, while similar lands outside the berry district may be bought for $10 an acre. But

trucking has at best a limited market; the crops are intensive, and at most only a small portion of the long-leaf pine soils can be used for truck. Some of these lands have yielded two bales of cotton to the acre and sell for more than $100 an acre, but only after long and skillful building up.

Cut-over lands must, of course, first be cleared of brush. This is easy if the lands have recently been cut over, for there is little undergrowth in the virgin forest; but upon lands long cut over this clearing is expensive. For the first crops it is not necessary to remove the stumps, since the plow can be run around them. Furthermore, it is now possible to extract the resin from the stumps. Thus not only can the removal of stumps be paid for but in some instances profits of $15 an acre or more have been realized in addition. As the grain farmer of the West has so often "mined" his soil, so the farmer in this belt has in many cases with his cheap lands found it easier to clear new fields than to build up old ones. The old fields are often "turned out" to become covered with brush, and one may often see old cotton rows extending through young forests. Such a wasteful method will probably continue for some time; but the South, like many other sections, is faced with a shortage of labor, which will tend to lessen this practice. In the pine belt the mobile labor tends to drift toward the mills, and fresh land requires extra labor for clearing. Furthermore, the newly cleared land is too rough for the machine cultivation which is to replace hand cultivation. In short, the sandy pine lands in their present state are not adapted to quick, profitable yields of such crops as the corn and wheat of the Middle West. They must be built up; but during the process the fertilizing legumes, which grow so readily, will provide hay and grazing. Then, too, the long seasons permit an almost continuous use of the land.

Live-Stock Raising. Stock-raising on an extensive scale calls for cheap grazing lands available for as large a part of the year as possible. Such conditions were supplied by our western lands before the ranch was crowded out by the farm. Grazing is being pushed to the dry lands, and these are shrinking as water is found to irrigate them. Thus, with the rising cost of meats come new inducements to live-stock raising, and the southern pine belt offers the most readily available lands for this needed live-stock expansion. The mild climate

permits open-air maintenance nearly all the year around. The wild grasses of the cut-over lands grow in the spring and summer and furnish fairly good pasturage, but by autumn they have dried, not to the nutritious hay of the West, but to a woody remnant that will scarcely afford sustenance. Here again, however, nature has provided a substitute in the hardy, nutritious *Lespedeza*, or, Japan clover—a nourishing grass which occupies the cut-over land and which, being a legume, adds nitrogen to the soil. The stockman should provide fall and winter grazing, and for this nothing is better than the cowpeas and velvet beans which grow luxuriously but require plowing and sowing each year.

The razor-back hog and "piney woods" cattle of this belt do not connote the symmetrical, bulky, heavy swine and steers which are associated with our ideas of luscious hams and tender steaks. These denizens of the pine lands have evolved from generations which were obliged to "rustle" far and wide for food, and one must be strong of jaw and vigorous of digestion to relish their meat. This native stock, however, has a most valuable characteristic; they grade well with blooded sires and transmit their own hardiness together with the size and meatiness of blooded stock. Sheep-raising is an industry of cheap new lands. Sheep will graze on rough lands and will consume not only grass but young brush. This industry is no longer an experiment on cut-over lands; flocks up to thousands are flourishing on the well-drained cut-over lands of this belt. The high prices for dairy products in recent years have stimulated this industry in the South as well as elsewhere. The dairyman and his herd, however, require years for their upbuilding, and scarcely more than a promising beginning has been made on the cut-over lands. Yet, enough has been done to show that dairying is entirely practicable.

Mixed Farming. It appears that, generally speaking, the successful farmer on cut-over lands will combine stock-raising and cropping. Live stock need legumes, which require cultivation, while the corn-and-cotton farmer needs live stock for the upbuilding of his lands. The average farm in the United States comprises about 130 acres, and the cut-over lands ready for settlement each year would provide nearly 60,000 of these farms and support something like 200,000 people. It is not easy to predict the future, but it is probable that a considerable acreage will be retained indefinitely by the holding

companies. Large ranches will be given over to the raising of live stock together with some production of legumes for winter feeding. A considerable area will be divided into farms of moderate size, especially near towns and along good roads. Some lands will be reforested. The development of these lands awaits immigrants either from densely settled portions of the United States or from abroad. High prices of farm products will probably check or possibly reverse the present movement of our population cityward. Immigration from abroad may be resumed and flow to these cheap lands and this mild climate. Whatever the final solution of the problem, the development of this southern empire is important both to the South and to the nation.

9. GEOGRAPHIC DIVISIONS OF TENNESSEE[1]

Tennessee may be divided into six geographic regions as follow: (1) the Appalachian Mountains, a narrow barrier on the eastern border; (2) the Great Valley of East Tennessee, a broad depression containing a succession of parallel ridges and valleys; (3) the Cumberland Plateau, a broad barrier region; (4) the Highland Rim or Plain; (5) the Central Basin or Plain; (6) the West Tennessee or Gulf Embayment Plain, subordinate to which may be noted the western valley of the Tennessee River and the flood plain of the Mississippi. These regions will be discussed in the order given above.

Appalachian Mountain Region. The eastern boundary of the state is formed by the crest line of a linear series of ridges that extend from Georgia to Virginia and beyond. These ridges are sharply defined, steep-sided, rough and very sparsely settled They attained heights of 4,000 to 6,000 feet in parts of the course. From these ridges on the boundary line numerous spurs project westward, in some places for a distance of 10 to 20 miles into the state of Tennessee. These spurs are separated by steep, narrow valleys, many of which end in secluded coves well hidden among the ridges. The region as a whole is a great barrier that has always limited or prevented communication across it, save in certain favorable places.

[1] Adapted from L. C. Glenn, "Physiographic Influences in the Development of Tennessee," *The Resources of Tennessee*, April, 1915, pp. 44–63. Mr. Glenn is professor of geology at Vanderbilt University.

The effect of these mountains has been and must always be to separate the people on either side. They are a very effective barrier and in the early days lead to isolation and neglect on the part of the North Carolina government, for the people who had settled in what was then its western portion. This condition culminated in the virtual secession of the east Tennessee settlers and the formation by them of the short-lived independent state of Franklin. Today while the few roads and several railroads that cross the region permit a certain amount of communication, it is still true that the main line of travel and of trade is not east and west across these mountains, but is northeast and southwest in a direction parallel to them. The Southern Railway, that formerly ran its best trains from Knoxville east to Washington by way of Asheville, now runs them north by Bristol, even though it has to use the tracks of another railway system from Bristol to Lynchburg in order to utilize this better route.

These mountains exert a very definite and positive influence upon the few settlers who are living among them. Those in the more remote coves are isolated, enjoy few opportunities for schools and churches, mingle but little with the rest of the world, and in general have a greatly narrowed horizon. Under such circumstances old social customs and forms of speech, as well as old political and religious beliefs, are preserved long after they have passed away in more progressive communities.

In a few places in these mountains there are deposits of iron, copper, slate, or other materials of economic value, and on the surface there grow in most places, magnificent forests of hardwood trees. The surface in many places is too steep to cultivate without serious soil erosion. There are, however, mountain benches, many coves, and small stream valleys that may be cultivated, and the forested lands may be grazed. Mining, lumbering, and some special forms of agriculture, such as grazing and fruit raising, offer the most promise for the future of this region.

Great Valley of East Tennessee. This is a broad belt 30–60 miles wide, that crosses the eastern part of the state from Alabama to Virginia, and consists of numerous long, narrow valleys, separated by narrow, parallel mountain ridges that trend northeast and southwest, in harmony with the general Appalachian structure. The valleys are rolling surfaces, formed by the solution of the limestone that

underlies them. The ridges are narrow, steep-sided, and for most part run in straight lines. They are formed generally by the upturned edges of the more resistant rocks of the region, many of which are cherty limestones. These ridges vary in length from a few to many miles, and their ends in many instances overlap each other in such fashion that in traveling across the Great Valley, it is necessary to make many detours around their ends. Travel northeast and southwest parallel to the ridges is direct and easy. As a result, the main lines of communication, whether by highway or railway, are those paralleling the topography. Railways that cross the Great Valley, such as the Southern from Knoxville to Clinton, or the Louisville and Nashville from Knoxville to Dossett, either make extensive detours in threading their way through the gaps of successive ridges, or resort to long and expensive tunnels where they attempt to go direct.

In the larger valleys, farms of large size were possible, and in some places slave owning became profitable. In most places, however, the ridge and valley topography was unfavorable to the development of large landholdings and of plantation life, and smaller farms became the rule. Slavery did not obtain the same hold on this region that it did in middle Tennessee. Sentiment on the subject of slavery was greatly divided and abolition societies were founded years before the Civil War. During the war east Tennessee furnished soldiers to both the Union and the Confederate armies, though Union sentiment was predominant. The political beliefs of the region are also a consequence of the same conditions. Most parts of the region are today strongly Republican. Had the surface of east Tennessee been such as to make slavery universally profitable, its history before, during, and since the Civil War would have been different from what it has been.

Agriculturally, the valley portions are much more desirable as a rule than the hill portions, and through the principle of the survival of the fittest there has come about a slow differentiation among the people as a result of which the more thrifty and progressive occupy the fertile limestone valleys, and the less energetic have been pushed into the poorer lands of the shale hills and chert ridges. This differentiation once established tends to perpetuate itself, and we find in some places the contrast between the peoples in the valleys and

back in the hills very sharply drawn and strongly marked. Needless to say this condition of affairs brings with it certain problems of a social and economic nature.

The wealth and variety of the mineral resources that have been made accessible by the upturning of the rocks of the region, together with other natural advantages, such as the proximity of coal, forest materials, and water-power, make possible the development of a greatly diversified urban industrial life.

This valley region, cut off from free communication both east and west, has its natural outlet northeastward into Virginia and southward and southwestward into Georgia and Alabama, and commercial and social ties and interchange of people and ideas must always be chiefly in these directions.

Cumberland Plateau. This division forms a belt 30–50 miles wide that extends entirely across the state from Kentucky to Alabama. Its surface has an average elevation for most of the area of about 2,000 feet above sea-level, though its culminating points rise to more than 3,500 feet. Its eastern edge is well defined, but its western edge has been made very irregular by the headwater erosion of the streams that rise on its western margin. The surface of about five-sixths of the plateau is a gently rolling one underlaid, for the most part, by a massive sandstone, but here and there the surface is formed of shales that are in places interbedded with the sandstones. That portion of the surface, however, which lies east of the Cincinnati Southern Railway is not properly a plateau, but is a complex maze of sharp-topped ridges and deep-cut, narrow stream valleys, formed on flat-lying shales and sandstones, by vigorous stream erosion. The larger streams of most of the plateau are sharply cut beneath the general surface and many of them flow in narrow gorges 300–500 feet in depth, the valley walls in many places being made of precipitous cliffs that may be in extreme cases 100–200 feet in height.

The eastern margin known in the southern part as Walden Ridge, and in the northern part as Cumberland Mountain, is itself a steep-walled barrier that is broken by but few gaps that permit easy access to the plateau surface beyond. In addition to this, the plateau as a whole must be considered as a broad barrier, separating middle and east Tennessee. The northern half of it, as has been said, is a maze of sharp-topped ridges and deep, narrow valleys in its eastern part,

while its western part, although the general surface is almost flat, is broken by many deep, narrow stream gorges, so that it is not possible in this section to establish easy means of communication across the plateau. The southern portion as far north as the head of Sequatchie Valley, is also difficult to cross, because of this valley. There is left, consequently, only a relatively narrow middle belt across which communication east and west may be established with any facility whatever. Today one may often travel in certain sections of the plateau five or ten miles without seeing a clearing or a habitation, and in eastern Fentress and Pickett counties there are many square miles without an inhabitant. The country is so rough and wild that it has always been popularly known as "the wilderness." It is perhaps more nearly a wilderness in the true sense of the word than any equal-sized area east of the Mississippi River.

For years the only railway connection between middle and east Tennessee was through the break in the plateau on the southern margin of the state where the Tennessee River cuts its way westward and southwestward across it. This railway, the Nashville, Chattanooga and St. Louis, long enjoyed a monopoly of transportation between these otherwise separated sections, and was largely instrumental in the development of the city of Chattanooga at the eastern terminus of this crossing. Efforts were made for years to establish railway communication across the plateau proper, but these were successful only in very recent years, when the Tennessee Central was completed across the middle section of the plateau, utilizing almost the only practicable route for a trans-plateau railway. Notwithstanding this, it is greatly handicapped by heavy grades on the east and west margins of the plateau.

The soils of the plateau are as a rule thin and sandy, and yield, under the ordinary careless methods of cultivation, only scanty crops. They are, however, under skillful management, capable of much improvement. Grazing and fruit growing are among the most promising agricultural pursuits, but the region cannot attain its best development until radical improvements are made in the methods of agriculture usually practiced, and these improvements are matters of slow introduction. Over most if not quite all of the plateau slavery was unknown, and the inhabitants cared nothing for it and had little or no interest in the problems that grew out of it. During

the Civil War, they either remained at home, or, if they entered the contest, they divided along lines of cleavage made possible by the existence of old family or neighborhood grudges and feuds, and a good part of the fighting was of a local or guerrilla character between bands of so-called home guards. The passions thus engendered lingered for a time but have since died away, and the feud, as an institution, can hardly be said to exist in the Cumberlands today. Moonshining is prevalent in certain communities, but is by no means universal, and the moonshiner is not in most cases the desperado that the reporter and novelist picture him to be.

The population in some of the plateau counties is practically at a standstill. Houses are so widely scattered that the inhabitants are greatly isolated, and suffer from the many effects of such isolation. Such conditions make for monotony in life and prevent development along many lines that are possible only in a more thickly inhabited country. Schools, churches, roads, villages, and other features of community life are but poorly developed. Living conditions in many cases are correspondingly primitive.

Present conditions are complicated in part of the region by the fact that much of the land within the past few decades has passed into the hands of large companies that have purchased it for the coal and timber. In some cases these companies permit and even encourage the original inhabitants to remain upon the land, on what practically amounts to a system of free tenantry, since they consider their presence desirable for the protection that they may afford against forest fires and depredations by timber thieves or other trespassers, as well as to furnish a source of labor for the operation of mines, logging camps, and lumber mills. In some other cases, however, the policy of the large land-owners has been to encourage the original inhabitants to remove from the tracts and in such sections their former homes have gone to decay, their small mountain fields are growing up in forests again, and in a few decades almost all signs of civilization will have disappeared.

Highland Plain. This physiographic unit is somewhat complex and is difficult to define in simple terms. From the Cumberland Plateau it stretches westward approximately to the Tennessee River, where it crosses the western part of the state. From an elevation of about 1,000 feet on the eastern border the surface of this plain slopes

gently westward to an elevation 600–800 feet. In middle Tennessee, in the very heart of the region thus included, the rocks which elsewhere lie horizontal beneath the plain have been slightly up-arched into a low dome from which erosion has eaten out an oval basin 60–80 miles wide and 150 miles long, with a surface 300–400 feet below the general level of the encircling Highland Plain. This plain is in consequence more usually known as the Highland Rim, a term, however, which ignores the true nature of the highland surface as a plain that in many places is well developed and of broad extent. The edges of the rim surrounding and overlooking the Central Basin are intimately dissected into steeply rounded hills and spurs that form one of the roughest parts of the Highland Plain. Another portion of the plain that is well dissected by streams is the part just east of the Tennessee River in Hardin, Wayne, Perry, and adjoining counties. Erosion here has been not more than 100 or 200 feet in depth, and even the worst eroded part of the region presents no such obstacles to travel and free communication as are presented by the deeply dissected portions of the Cumberland Plateau.

The settlement and subsequent development of the Highland Plain have been largely controlled by these soil differences. In areas of good limestone soils it has been but natural that the inhabitants should become more prosperous and progressive than those in areas of poorer shales and sandstones. In fact many areas of these poorer soils have an exceedingly scant population even today, while the more fertile limestone areas are thickly settled and prosperous communities. The growth of the towns of the region has depended, like the general growth of the population, upon the fertility of the soil of their immediate vicinity and their relative size and prosperity is at once a result and an index of the general fertility of the particular section in which they are each situated, since their prosperity depends almost entirely upon the agricultural resources of the surrounding country.

The future development of this region must show, as its past has shown, differences in development that are traceable primarily to differences in soil fertility. Some sections will always be more prosperous than others. Improved methods of agriculture have, however, shown within recent years that it is possible to handle the soils of the poorer areas in such manner as to produce excellent crops.

The general adoption of these improved methods must lead to increasing prosperity in such areas, and these will tend to minimize the social and industrial differences that now exist between the more and the less fertile sections of the Highland Plain. The future of the region is almost entirely agricultural since there are, generally speaking, no mineral deposits of great importance save in certain sections of the western portion where, locally, iron ores are abundant. Much of the timber of the region has been cut and the tendency is, as everywhere, toward its further destruction. This section is capable of supporting a very much larger population than it now has, under conditions that will vary from medium to good, and there is no inherent reason why it should not as a whole become quite a prosperous section of the state.

Central Plain. This division of the state forms a basin that has been produced by the erosion and unroofing of the gentle dome mentioned in the description of the Highland Plain. It is 50–60 miles in width and about 100 miles in length, with its longer axis extending somewhat northeast and southwest. Murfreesboro is a few miles southeast of the center of the basin and Nashville is situated near its northwestern margin. The general surface of the plain is gently rolling and is some 300–400 feet below that of the surrounding Highland Plain.

It was produced by stream erosion and solution on limestones, whose doming is so gentle that they are almost flat-lying. The soils of the region are the insoluble residue left by the solution of the limestone. Where this solution has been more rapid the soils form a thick surface mantle, but where the limestones are more cherty and hence less soluble, the soils are thin and the surface is glady. A portion of the limestones contain a considerable percentage of phosphatic matter, and their solution has left a soil unusually rich in the form of plant food. The soils of this phosphatic type attain their best development in the region of Columbia and Mount Pleasant, and this is the secret of the high, natural fertility of that and some of the other portions of the Central Basin.

The development of highways presented no difficulty on such a rolling to nearly level surface, and roads were built wherever desired. The same thing has been true of railways. They have been constructed without difficulty across any part of the Central Plain.

They have, however, met with considerable difficulty when attempting to leave this plain, since it has been necessary for them to climb some 300 or 400 feet in order to reach the level of the surrounding Highland Plain. The Louisville line of the Louisville and Nashville, Railroad, for example, has heavy grades where climbing out of the basin north of Nashville.

The development of civilization on the Central Plain has probably been more homogeneous than elsewhere in the state. Conditions there on the average have been better than elsewhere, and so there was in early days a rather more rapid settlement of the region and development of culture and wealth. Land holdings were often large, and farming on an extensive scale by slave labor was usually profitable. The sympathies of the people were in consequence strongly southern, and in the Civil War they entered the Confederate Army. Since then the region has been Democratic in political faith.

So far as physical conditions go there is no adequate reason for any marked difference in political faith or social or industrial life in the Central Basin. Practically all interests and pursuits are similar, the soils and products are largely similar, and hence all phases of community life may be expected to be much alike. Such political differences as have marked some sections of the region in the past have been due to the strong personality of some political leader whose influence and personal following have swayed the votes of his county or section at certain times in some special direction. These differences have usually disappeared soon after the leaders that caused them have ended their political careers.

West Tennessee Plain. This is a part of the Gulf Coastal Plain which reaches its northern limit in southern Illinois. The eastern edge of this division may for the present purpose be taken as the Tennessee River in its northward course across the western part of the state. The plain slopes gently westward from an elevation of from 500 to 700 feet on its eastern margin to an elevation of 300 or 400 feet, where it overlooks the Mississippi flood plain. Its surface is a gently rolling one that becomes somewhat broken along the main streams. It is distinctly hilly along its eastern margin facing the flood plain of the Tennessee River, and its western one overlooking the flood plain of the Mississippi. The streams that drain its surface head near the Tennessee and flow westward into the Mis-

sissippi. They have cut their channels down to low grades, flow sluggishly in meandering courses, and have developed flood plains from a half to several miles in width. Owing to their low grade, these flood plains are usually swampy, and one of the present-day problems of the region is the drainage and reclamation of these swampy lands. The upland soils of the region are either sandy, loamy, or clayey, and the distribution of the soil types is dependent upon the various geological formations of the region. These outcrop in belts whose general course is north and south. The sandy soils may be, according to circumstances, either fertile or infertile. The loams are usually fertile, while the clays are usually poor.

The settlement of the country has been confined to the uplands away from the swampy flood plains. Farming on an extensive scale became the rule wherever the soils were good, slavery and cotton became features of the life. The slave owners were of course southern in their sympathies, and have been Democratic subsequently in their political faith.

Along the Mississippi, there is usually a flood plain of some width between the stream and the edge of the upland. At three points, however, the river swings against the upland on the eastern side of its valley and has formed bluffs. Towns known as Fulton, Randolph, and Memphis were early founded on these three bluffs.

The future of the west Tennessee region should be that of agricultural prosperity. There is already much good agricultural practice, and with further improvement of conditions in farming, the development of better roads, the drainage of the river swamps, and the further extension of truck and small fruit farming, there should be an excellent basis for permanent community prosperity. There are, however, in the region just enough lands that are naturally poor to give a semblance of excuse for local thriftlessness, and so we may expect for years that backward communities will exist locally in the region.

In its lower course the Tennessee River flows north across the state and has cut a valley usually several miles in width to a depth of 300–500 feet beneath the upland plain on either side. Much of this valley is above the reach of ordinary floods and it is largely cleared and farmed, though there are parts that are low and swampy.

Except at the three bluffs mentioned above, there is a variable width of flood plain between the western edge of the upland plain of west Tennessee and the Mississippi River. Near the banks of the river, this flood plain is high enough to remain above water in all but the highest floods. Much of this part is cultivated. Farther back from the river the elevation is less and the surface is frequently flooded. It is poorly drained and swampy and is not cleared. With the perfection of the levee system and the drainage of the lower parts, this rich alluvial land should produce immense crops and support a large population.

The Three Grand Political Divisions of the State. The features of the state lend themselves easily to a threefold division for political purposes that has been long recognized and observed. The division is into east, middle, and west Tennessee. The line separating the east and middle divisions crosses the Cumberland Plateau so that it is divided somewhat equally between them, while the line separating the middle and western divisions is approximately the lower or northward portion of the Tennessee River. East Tennessee is Republican in politics and is interested in diversified agriculture, mining and manufacturing, while middle and west Tennessee are Democratic politically and interested primarily in agriculture. The two latter divisions, with their common politics and similar, though by no means identical, interests, usually dominate in political matters.

In early days there was a land office and a treasurer for each of these three divisions. The supreme court still sits in rotation in east, middle, and west Tennessee. There is a state normal school for each of the three divisions and a state asylum for each division. In the constitution of political boards and committees it is usually specified that equal representation be given to each of these three divisions, so that in many ways the state comprises three separate communities more or less distinct and different from each other, and yet united under one system of government.

CHAPTER XI

INTERIOR UNITED STATES

1. THE GREAT CENTRAL PLAIN OF NORTH AMERICA[1]

The Great Central Plain extends 2,500 miles northward from the Gulf of Mexico, and 1,500 miles eastward from the Rocky Mountains to the highlands of New York. A large portion of the northern third of this great area is covered by snow and ice many months in the year and a broad strip along the western border is too dry for diversified cultivation, yet there remain fully 1,250,000 square miles of land capable of the highest agricultural development. Man in North America is only in the early stages of his adjustment to the soil. For many decades certain sections of the Central Plain have contributed largely to the world's cereal crop; the ultimate agricultural possibilities of the region, however, are far from being attained.

The resources of the Central Plain lie not alone in its agricultural possibilities, for there are rich deposits of iron, salt, coal, copper, gypsum, and various sorts of building materials. The great stretches of valuable forests which once covered much of the region have played an important part in the development of the region about the Great Lakes; and furs, the pioneer product of the forests for which the eastern section of the Central Plain was coveted by both the French and the British, have long since been depleted.

The Central Plain is in general of low relief. Minor elevations here and there break its monotony, but these offer little obstruction to intercourse between the various parts. Although the Great Central Plain does not border an ocean, its low relief, its many navigable rivers, bays, and gulfs, and the low passes through the highlands to the east, all permit freedom of intercourse with the Atlantic, the most important ocean in world-commerce. To the north there is easy access to Hudson Bay. Though ice-bound for seven or eight months

[1] Adapted from A. E. Parkins, *The Historical Geography of Detroit*, Michigan Historical Commission (Lansing, 1918), pp. 2–9. Mr. Parkins is professor of geography at George Peabody College for Teachers.

each year, this exit to the Atlantic was an important one for the fur trade of the regions to the north and northwest of the Great Lakes for over two hundred years, and in the future it may prove of great value to the developing regions in the northern part of the arable portions of the interior plain. On the south for 1,500 miles the Great Central Plain borders the Gulf of Mexico. Along this coast there are ports with easy communications to the interior that may serve as logical doorways to the trade of Central and South America. Along the eastern border are the highlands of Canada and the Appalachian Mountains. These are the only barriers between the Plain and the Atlantic. Around the northern end of the Appalachian ridges, along the southern border of the "old land of Canada," extends the St. Lawrence Valley, the lowlands of which, as far west as the escarpment at Niagara, are less than 500 feet above tide. To the south of this great valley, across the state of New York from the plains about Lake Ontario to the Hudson River, is the Oneida-Mohawk depression, also with low altitudes. These two valleys constitute the notches in the barrier to the east. These have ever been among the chief, if not the chief, lines of communication and traffic, the "gateways" between the Great Central Plain and the Atlantic Ocean.

The Great Lakes region includes that irregular and somewhat indefinite area, on the eastern side of the Great Central Plain, that borders and includes the five Great Lakes of North America. It is not separated from the other parts of the Great Central Plain by any marked topographic feature. It is not in any way an isolated geographic unit; yet it is a unit. Its abundant resources make it one of the most important areas of the interior plain. Its chief importance perhaps lies in its position at the west entrances of the "gateways" to the Atlantic. Since the great markets for agricultural products are in eastern United States and Europe, this position makes a large part of the Great Central Plain naturally tributary to the Lakes region. During the long period that the merchants of Montreal and Quebec controlled the economic activities of the great interior of North America, the area tributary to the Great Lakes included most of the territory to the north of the Ohio and the Missouri rivers, and west to the Rocky Mountains. Today the Great Lakes region has

for its sphere of commercial influence more than two-thirds of the Great Central Plain.

Great as are the resources of the mines, the forests, and the fields, the Great Lakes region owes much of its importance to the Great Lakes themselves. There are few other regions of like area that can furnish such opportunities for inland transportation. From the lower end of Lake Michigan to the eastern terminus of Lake Erie there are nearly a thousand miles of unobstructed deep waterways. With the overcoming of the barrier at the rapids of the St. Mary's River and the falls at Niagara, six hundred miles more have been added. But transportation advantages on lakes are not to be reckoned by the length of the lakes. Innumerable cross-routes multiply the above milage many times. Besides the many hundred miles of deep waterway, there are many minor waterways suitable for smaller craft. These minor water courses were very important in the days when canoes were the chief carrying agent.

In the northeastern part of North America, there is a great area of crystalline rocks, granites, gneisses, and schists. This is the so-called North American "shield," the "old land" of Canada. To the south of this crystalline area, poor in agricultural possibilities because of its long winters and thin soils but rich in mineral deposits and water power, are younger sedimentary rocks. The younger rocks are chiefly sandstones, limestones, and shales, which in general are eroded much more easily than the crystallines.

Though these striking contrasts of bedrock offer the conditions for differential erosion, it was mainly the waters and the ice of the Glacial Period that gave much of the land in north central and northeastern North America its present topographical expression. In some sections erosion took place, in others deposition.

The "old land" was swept bare of its residual soil, the accumulation of ages. At places in the "old land," where conditions were suitable, lake basins were gouged out. These lakes are numbered by the thousands in the Laurentian Highlands. Many are connected by rivers, making many nearly continuous water routes, suitable for canoes from the St. Lawrence Basin to Hudson Bay. In the region of the younger, sedimentary rocks, the work of the glacial ice was much more pronounced. The basins of most of the

Great Lakes are partially, if not largely, the result of the erosive action of the ice upon the limestones and shales. The material eroded from the sedimentary rocks, combined with that from the "old land," was strewn here and there in a more or less systematic fashion, forming moraines, outwash plains, till plains, valley trains, and other features over the broad plains between the Great Lakes and the Ohio and Missouri rivers.

2. THE RELATION OF RELIEF, SOIL, AND DRAINAGE TO AGRICULTURE IN OHIO[1]

Topography does much to influence the type of farming in Ohio. There is a wide diversity of topography, ranging from level plains with not more than 10 feet change in elevation for several miles, to rough hills with steep slopes and ridges rising almost vertically from the stream valleys to a height of 300 to 500 feet. In the more level areas drainage is still deficient, while in the more hilly sections the rainfall runs off rapidly and much damage is done by erosion.

About one-fourth of the state may be called hilly. This comprises essentially the non-glaciated southeastern section of the state, in which the relief consists of a succession of hills and sharp, winding ridges, separated by deep, narrow valleys. There are, however, many small areas where the surface is level or gently rolling. The boundary between the hilly and the level section is in some places very distinct, while in others there is a gradual grading of hills into level prairies.

Approximately three-fourths of the state, comprising the western and northern sections, consists of level to rolling plains, formerly covered with forest. This is the glaciated part of Ohio. With the exception of a few areas, this land lies well for tillage, consisting of gently rolling plains with just enough change in elevation to give, as a rule, good drainage. Extended areas, however, have needed to be ditched before allowing of full development, while much is still in need of adequate drainage. The largest area of this level country is in the northwestern part of the state in the bed of an old lake.

Another distinct type of farming is to be found upon the bottom lands. Throughout most of the hilly counties, as well as in the level

[1] Adapted from J. L. Falconer, "Ohio Agriculture from 1850 to 1910," Part II of "The Agriculture of Ohio," *Ohio Agricultural Experiment Station, Bulletin 326*, pp. 233–48.

section of the state, are found strips of bottom land along the rivers and streams. Probably the most extensive of these are along the Ohio and its tributaries, the Miami, the Scioto, and the Muskingum. As a rule, the bottom lands along Ohio rivers are narrow, yet they have been outstanding in Ohio agriculture since the beginning of farming in the state.

Corn and Clover Follow Limestone Areas. Practically all that portion of the state lying west of a line extending from Sandusky south to the Ohio River through Columbus is underlaid with limestone. East of this line the soil formation consists mainly of sandstone and shale. These soils are generally acid. There are, however, limited areas of limestone soils in the southeastern part of the state. These variations in soil and topography are of fundamental importance in determining the type of farming.

The distribution of the corn and clover acreage of the state shows quite clearly the line separating the two soil areas. West of the line is the corn- and hog-raising section of the state; east of this line there is less corn produced, and the acreage has tended to decrease during the past fifty years. On the west, there is more clover grown than on the east. On the east, grazing, with dairying and sheep-raising, has been and was in 1910 the major source of income from the farm, although wheat, potatoes, and fruit add materially to the income in many counties.

Hilly Sections Adapted to Live-Stock Farming. In the hilly section of the southeastern counties, a large part of the land is too steep for general crop farming and much of the remainder is cultivated with some difficulty when compared with that in the western half of the state. Much of the land in farms is in untillable and woodland pasture. For this reason a large part of the receipts on the farms of this section has always been from live stock and live-stock products. On the hill farms corn, then wheat or oats, followed by hay for two or more years, is the usual cropping system. On the bottom land more corn and less hay is grown.

Dairying Predominates in Northeastern Counties. In the northeastern counties, especially in the region of the Western Reserve, dairying has been the predominating enterprise since 1850. Poor drainage and an acid soil have not been conducive to a large corn area. In recent years much of the corn raised has been put into the

silo for winter feeding. Wheat has always been a minor crop. Since 1860 the acreage in oats has increased. In the extreme northeastern counties buckwheat was an important crop in 1910. Hay has always been the predominating crop and when not consumed by the dairy cow provides an important source of income for many farms. Since 1880 an area in potatoes has been rapidly increasing and on many farms in 1910 provided the chief or only cash crop. On many a farm the sale of maple syrup adds materially to the annual income. The area in crops was nearly the same in 1910 as in 1850.

Because of the small corn area hogs have never been an important source of income in this region, while the prevalence of dairying tended to keep out sheep. Much hilly and poorly drained land has provided an abundance of pasture area. Growing local markets have created a demand for market milk.

The Wheat Counties. On the northern edge of the hilly area and south of the Western Reserve is a group of counties known as the "backbone counties" of Ohio. These counties have continued to be the leading wheat-growing counties of the state since its early settlement. They have also steadily maintained a position among the leading oat-growing counties. For the past sixty years clover has here occupied a greater part of the total hay areas than in any of the other eastern counties. As for live stock, the dairy cow predominates.

In all the northeastern counties and also in some of the southeastern counties are more or less extensive orchards which, when well cared for, provide good returns. Of recent years, with the development of good roads and local markets, the growing of truck crops and the keeping of poultry have increased. Along the lake shore, vineyards and small fruits are extensively grown.

The Corn Counties. With the exception of the Ohio River district, corn is the leading crop of the western counties. Here the average yield of corn is considerably above that of the eastern counties. Level land and a limestone soil have been favorable to crop production. A smaller hay acreage and more grain crops are grown than in the eastern counties. A much larger proportion of the total hay area is in clover. As for live stock, hogs and beef cattle predominate, while sheep are quite extensively raised and fed in the north central

counties. Of recent years, dairying has been extending in the vicinity of the large cities and in Fulton County, where several condensaries have been built.

The northwestern section of the state was the last to be developed. Here the type of farming in 1910 was essentially similar to that in the corn-growing counties of the southwest. In the extreme northwestern counties oats exceed wheat in acreage planted. Since 1900 the area in sugar beets has been rapidly extended. In the old lake-bed region, in 1900, there was a growing tendency to rotate the crops with clover. In former years it had been the practice to grow corn after corn for years in succession until the stumps were rotted out, then to follow with a rotation of corn and oats, while more recently one of corn, oats, and clover has come into favor. In the sugar-beet area the beets take the place of corn in the rotation. Drainage and better cultivation of late years have made the crops more certain. The northwestern counties lead all other sections of the state in the amount of feedable crops sold. The sale of oats contributes largely to this. The amount of live stock to crop area is less than in the southwestern counties.

On the bottom lands of the state, corn has been and still is the leading crop. On some fields in the Scioto Valley corn is grown year after year on the same land. Others rotate their crops with two years corn, then wheat or oats, then clover.

In many sections of the state vegetable-growing has developed. Examples of this are the Scioto Valley, where canneries have been established, and in the Muskingum River Valley, where vegetables, especially corn, cucumbers, tomatoes, and cabbage are extensively grown for the Pittsburgh market. Along the watershed which divides the Ohio River from the Great Lakes is a series of marshes, many of which have in recent years been drained and extensively given over to vegetable production. In the neighborhood of the large cities, as Cleveland, Cincinnati, Columbus, and Toledo, market gardening is extensively carried on. Grape production along the Great Lakes has largely developed. Orcharding in the greater part of the state is carried on as a part of the general farm business. In the last three decades, however, many commercial orchards have been developed along the Lakes, in the northeastern counties, and in southeastern Ohio.

Cattle the Chief Live Stock of Ohio. From the earliest settlement of the state cattle have occupied the leading position in its live-stock industry, the potential feed consumption of cattle exceeding that of horses, sheep, and swine combined. The cattle business of Ohio was in a flourishing condition during the fifties. Ohio and the blue-grass region of Kentucky at that time constituted the prominent cattle regions west of Pennsylvania. The building of the through railroads brought about many changes in cattle feeding in the state. During the previous decades Ohio had occupied a unique position in the beef-cattle business. Located on the eastern edge of the corn belt, it had been the practice of Ohio feeders to purchase cattle in large numbers in Indiana, Illinois, Missouri, and the West, or in the hilly counties of eastern Ohio; drive them to the corn-growing counties of southwestern Ohio, there to be fattened before starting on the long overland drive to eastern markets. By 1850 the driving of fat cattle from the region of the Scioto had reached its height, by 1860 it had almost ceased, for by that date cattle were sent east by railroad from the grazing lands of Illinois without stopping to be fed in Ohio.

3. AGRICULTURE IN WISCONSIN[1]

The Upper Mississippi Valley is a region of unusual fertility; one of the garden spots of the world. Wisconsin is included in this area. In the southern and eastern parts of the state, practically the whole area is farm land. In productiveness and value the land of this region ranks with the best in the United States. In the central part of the state is an area of sandy soil of much lower productivity, while in the northern part there are several million acres that are still in the condition of cut-over, burnt-over, and forest-covered land, awaiting development. Hence, when the whole state is taken into account, Wisconsin is outranked by such prairie states as Illinois and Iowa, and by some of the eastern states that have been settled longer. Among the states, Wisconsin ranks about tenth in the annual value of farm products.

Wisconsin is grouped with the agricultural states, although the gross annual value of its manufactures exceeds that of its farm prod-

[1] Adapted from R. H. Whitbeck, "The Geography and Industries of Wisconsin," *Wisconsin Geological and Natural History Survey, Bulletin XXVI*, 1913, pp. 27–58.

ucts. About 60 per cent of the land area of the state is in farms. Nearly all of the southeastern third is improved; but eleven counties in the northern part of the state had, in 1910, only about one-tenth of their land in farms. About 36 per cent of the land area of the state is improved farm land, and the farm property is valued at over one and a half billion dollars. In the southeastern third of the state the average value of land is around $100 an acre (1913).

Speaking in very general terms, there are three soil belts in the state, based upon the character of the underlying rock:

a) The glacial soils on the crystalline rocks of the north, both sand and clay.

b) The light soils on the sandstone rocks in the middle belt, both glacial and non-glacial.

c) The clay-loam soils on the limestone rocks in the southern belt, both glacial and non-glacial.

Over four-fifths of the soil of Wisconsin is glacial, and it is, as a whole, somewhat better than the average soil of the driftless region, though one of the best farming regions in the state is found in the southern part of the driftless area. The northern half of the state is developing steadily and it is proving to be well adapted to farming, and especially to dairying. The sandy soils in the central part of the state are less productive than the clay soils, because of (1) their low water-holding capacity, (2) the readiness with which they are blown by the wind, and (3) their lower degree of fertility. Rye, buckwheat, and especially potatoes are the profitable crops of the sandy soils.

The glacial till and the residual loam of the limestone belt are largely clay. These soils hold water, contain considerable lime, and are the most productive.

The hilly character of the southwestern part of the state has led to dairying and stock-raising. The clay soils favor the production of grass and hay and also lead to grazing. Cheese factories are particularly a response to summer dairying and are most numerous in the cooler parts of the dairying region. Creameries are a response to winter as well as summer dairying and are most numerous in the corn belt of the state.

Dairying and Dairy Products. The most notable development in agricultural lines in Wisconsin during the last decade has been in dairying. The state now stands at the head of the dairying states of

the union. In 1912 there were over three thousand cheese factories and creameries in the state, and the shipping of milk to cities is rapidly increasing in southeastern Wisconsin, due especially to the growing demands of Chicago and Milwaukee. The production of condensed milk is largely confined to the southeastern part of the state.

"The dairy industry has become the most important branch of agriculture in Wisconsin. The changes which have occurred during the period 1905 to 1910 show that both dairy farming and dairy manufacturing are securing a firm footing in the newly developed regions of the north. This, together with an increase in production in the older dairy regions, indicates a stable and permanent industry. Dairying as a farm industry is adjusting itself to the influences of the various factors—soil, climate, competing enterprises, and location with respect to the markets."

The following statements give the chief facts concerning this great industry in 1910–12:

a) There are as yet relatively few factories or creameries in the northern part of the state, due to undeveloped agricultural conditions.

b) Cheese factories and creameries are few in seven counties in the central portion of the state—largely due to the sandy character of the soil, unfavorable to pasturage.

c) Practically all of the three thousand cheese factories and creameries are in the region of clay soils whose water-retaining capacity favors pastures and meadows.

d) The creameries are most numerous in the corn belt; butter-making is a response to winter as well as to summer dairying; corn, in the form of ensilage, is the economical winter feed for cows; the corn belt closely coincides with the region of 150-day growing season, and in this belt cheese factories seem unable to meet the competition of butter factories.

5. The cheese factories almost monopolize a region near Lake Michigan and another in the rougher and higher lands of the southwest; for cheese-making is a response to summer dairying, prospers where the weather, especially the nights, are cool, and hence where corn-growing is less important.

6. Wisconsin leads in the making of Swiss cheese, chiefly carried on in the Swiss settlements in the southern part of the state. This cheese is more sensitive to soil and climatic conditions than any

other kind; the Swiss factories are nearly all on land 900 to 1,000 feet in altitude, and 95 per cent of the 275 factories are on limestone land, while 70 per cent of the 106 factories making Limburger cheese are grouped in the low valleys on sandstone land.

7. Northern Wisconsin, with its clay soil and cool climate promises to develop into another great cheese-making section.

8. Wisconsin's dairy products now amount to over $80,000,000 annually, have doubled in ten years, and are greater than those of New York, heretofore the leader.

9. This trend toward dairy farming is most beneficial to the agricultural interests of the state.

The great prosperity and the rapid development of the dairy industry in Wisconsin cannot be explained alone on the basis of geographic causes. A far-sighted man, ex-Governor Hoard, and an institution, the College of Agriculture of the state university, through their continuous campaigns of education have been significant factors in the growth of this industry. Natural conditions made profitable dairying possible; a well-directed policy of education brought it to its present high development.

In order of value, the leading crops of Wisconsin are: hay, oats, corn, barley, potatoes, tobacco, rye, wheat. The total value of dairy products is greater than any of these; equal, in fact, to the leading two.

4. ASPECTS OF THE PHYSICAL ENVIRONMENT IN A TYPICAL SECTION OF THE CORN BELT[1]

Iowa has but one primary physiographic form—the prairie plain. Taken as a whole it is the most typical prairie state of the Union. Here waving grasses once covered the rolling uplands and deciduous trees bordered the dark and slowly meandering streams. Now the deep, rich soils, moistened by ample and well-distributed rainfall, offer rich return for agriculture, and artificial groves dot the landscape in every direction.

The relief is slight. The total range in altitude between the valley floor of the Mississippi River where it leaves the state at

[1] Adapted from H. E. Simpson, "Topography and Climate of Iowa," chapter i of "Underground Water Resources of Iowa," *Annual Reports, 1910 and 1911, Iowa Geological Survey*, XXI, 48–59.

Keokuk and the highest mound on the great divide in Osceola County does not exceed 1,200 feet, a slight relief for an area of 55,475 square miles.

Originally this plain was an old sea floor. The alternating layers of sands, muds, and lime deposits of which it consisted were slowly cemented and consolidated into sandstones and limestones and raised by gentle uplift into the great interior plain which slopes southward from the old lands of Canada and the Lake Superior region. Time did not materially disturb the rock layers of this ancient coastal plain except to bevel off their surface, and they still dip away slightly to the southwest, with scarcely a fold or fault to break the unity. The surface variations were largely the result of long-continued erosion by weather and running water, greatly modified and almost obliterated over the larger portion of the state by glacial ice.

With the exception of a small driftless area in the northeastern corner of the state, every portion of Iowa was occupied by an ice sheet at least once during the Glacial Epoch. The general effect of the ice work was to wear away the more prominent topographic prominences, to fill the valleys, and to spread rock waste over the area. Portions of the state were several times invaded by ice, which left the sheets of till, varying in smoothness and thickness, that combine to form the present mantle of drift—a mantle averaging in thickness from 100 to 200 feet, with a probable maximum of 600 feet in Louisa County.

On the whole, the surface left on the retreat of the glacial ice was a gently undulating plain. Only near the margins of the drift sheets or at places where long pauses were made in the retreat of the ice front were marked irregularities produced. Here belts of hills with alternating depressions were formed by the irregular heaping up of the drift material, producing terminal or recessional moraines having characteristic knob-and-kettle topography. The material is chiefly till, a mixture of clay, sand, pebbles, and bowlders of all kinds, deposited directly by the ice. Associated with this are beds of sand and gravel left by streams of running water and fine clays deposited in quiet waters. Overlying the drift sheets of the earlier ice invasions over more than half the state is a fine porous clay of peculiar vertical cleavage called loess. This formation is of eolian or aqueous origin and can be readily distinguished from the underlying drift by its lack

of pebbles and bowlders. It tended to smooth over the slight inequalities of the drift sheets on which it was deposited.

The level character of the prairie plain is such as to favor the ready absorption of rainfall by the soils and to cause the ground water to stand near enough to the surface of the drift or the country rock to be within easy reach of comparatively shallow wells. The gently rolling character of the topography insures good drainage, thus preventing stagnation of water on the surface, and lowers the groundwater level far enough to permit purification of the downward percolating waters by filtration before they join the great underground system. The topographic conditions, in connection with drift soils such as are found throughout nearly all of the state of Iowa, insure an abundant and wholesome supply of underground waters at depths which permit most of the inhabitants outside of the large cities to be supplied at very slight cost.

5. SOME GEOGRAPHIC INFLUENCES OF THE LAKE SUPERIOR IRON ORES[1]

The Ore Fields. The Lake Superior ore district consists of six principal ranges: the Marquette and Menominee in Michigan, the Penokee-Gogebic in Michigan and Wisconsin, and the Mesabi, Vermilion, and Cuyuna in northeastern Minnesota. The latter are 60 to 90 miles northwest of Duluth-Superior and Two Harbors, from which the ore is shipped to lower lake ports. The Marquette Range is near the city of Marquette, the Menominee Range near Escanaba, and the Penokee-Gogebic Range 25 to 50 miles from Ashland. Thus each range has an adequate outlet by water, a factor of great significance in its development.

The Mesabi Range. Iron ore in the Mesabi Range was reported at Gunflint Lake in 1852, but the first ore pit was not made until 1890. Other discoveries of rich ore followed rapidly, and in 1892 29,000 tons were produced. The next year the district produced nearly 2,000,000 tons, and by 1910 the output reached 29,200,000 tons.

[1] Adapted from George J. Miller, "Some Geographic Influences of the Lake Superior Iron Ores," *Bulletin of the American Geographical Society*, December, 1914, pp. 881–916. Mr. Miller is head of the department of geography, State Normal School, Mankato, Minnesota, and editor of the *Journal of Geography*.

These ores, in most places, are covered thickly with drift. When this has been removed, great ore bodies of large horizontal extent, compared with their thickness, are exposed. This ore is a soft, porous, brown, red or blue hematite of high grade, and varies from a finely powdered to a compact mass. These conditions make open-pit mining with steam shovels very profitable, as the ore is loaded directly on to the railroad car in the mine. Conservative estimates give 3.1 billion tons of high-grade ore in the Mesabi Range, and more than 39 billion tons that are not available at present. It is therefore not only the greatest present producer, but, so far as known, has the greatest reserves of any Lake Superior range.

Ore Production. Except for occasional periods of depression, the production of each of the Lake Superior ranges has increased constantly. The production of the Mesabi Range has been phenomenal. Within four years after it was opened its annual output exceeded that of any other range. In 1916 its output made 55 per cent of the total from the Lake Superior region, and was nearly six times that of any other range. The same year the lake district supplied 85 per cent of the ore mined in the United States. This region not only dominates the iron and steel situation in America, but produces approximately 35 per cent of the world's ore. Thus it makes the United States the world's greatest iron and steel producer. It will not soon lose its leadership, for in 1910 it had 94.9 per cent of all the known ore reserves of the United States and 78.3 per cent of all the ore available under present mining and market conditions.

Reasons for Growth. Several factors have caused this rapid development and relative importance of the region. (1) The ore is of high quality. Until recently most steel was made by the Bessemer process, which demands high-grade, non-phosphorous ores. Much Lake Superior ore met these conditions and, once on the market, the demand for it grew rapidly. (2) Cheap mining methods are possible in most places. The character of the deposits made possible open-pit, steam-shovel mining on the Mesabi and comparatively cheap mining on some of the other ranges. In the open pits of the Mesabi district ore is mined at a cost of about 30 cents per ton, which is probably not equaled anywhere else in the world. (3) Transportation methods by water and rail and mechanical devices for handling

the cargoes have been so improved that the handicap of distance between the coke and ore has been nearly overcome. (4) The commercial and industrial development of the country has created an unprecedented market for iron and steel products. (5) The concentration of industries under the management of large corporations has made possible the expenditure of great sums in perfecting methods of mining, transportation, manufacture, and in the elimination of waste. While this has meant considerable profits to the corporations, it also has meant rapid development of the iron mines and of the iron and steel industries. No other industry gives employment to so many people and pays so much each year in wages.

Effect on Railroad Building. Before 1884 Minnesota had no railroads north of Duluth, except near the western border. That year the Duluth & Iron Range Railroad was completed from the Vermilion Range to Two Harbors. Progress in railroad building was slow, however, until 1890, when the first ore pit was opened on the Mesabi. Since then the growth has been rapid, until now a closely woven railroad web serves the region. There are three railroads built especially for handling iron ore. They aggregate "over 700 miles, with an equipment of 282 engines, and over 16,700 cars." They have so perfected the system of ore transportation that one road frequently handles more than a million tons a month.

The Sault Canal. Originally, navigation of the rapids of the St. Mary's River was impracticable except for logs and small craft. Before 1845 Lake Superior commerce was largely in furs. All ore, machinery, and other supplies had to be portaged around the rapids and reshipped. As the value of the mines became better known the necessity of a canal was realized, and since that date a 12-foot canal was completed in 1855. Its opening marked the birth of a new era. The canal admitted vessels of about 400 tons burden and fixed the size of the first ore-carriers. The Civil War supplied a new market for the ore and hastened development in northern Michigan. Canal traffic increased rapidly, and the canal was soon wholly inadequate to meet the growing needs of lake commerce. Accordingly, it was deepened to 16 feet in 1881, but the improvement scarcely was completed when the necessity of still greater depth was realized, and in 1896 it was deepened to 21 feet and larger locks built. A third

lock with enlarged dimensions and a separate canal, paralleling the old canal and locks, were completed in 1914, and a fourth lock in 1919.

Growth of Lake Commerce and Relation to Iron Ore. The commerce of the Great Lakes is (1) largely east-bound; (2) chiefly through traffic, especially between Lakes Superior and Erie; (3) mainly between a few ports; and (4) mostly in iron ore, coal, grain, and lumber. Since fully seven-eighths of all lake commerce passes through Lake Superior, the relation of that commerce to this problem is apparent. Iron ore not only constitutes more than two-thirds of Lake Superior commerce but more than half (53.6 per cent) of the total domestic commerce of the Great Lakes. It is evident, therefore, that the commercial prestige of the Great Lakes depends today upon the northern iron mines. This ore must meet the coke of Pennsylvania, West Virginia, and other distant states, hence it forms through bulk freight, making up 88.2 per cent of all east-bound traffic and 89.4 per cent of all iron ore transported on the Great Lakes. It has grown from 1,447 tons in 1855 to 41,603,000 tons in 1910. Grain, flour, and lumber make up all but 1 per cent of the remaining east-bound freight. It is also evident that vessels carrying iron ore, grain, and lumber eastward must return empty unless suitable bulk freight can be had. The iron district and an area extending many miles north, west, and south of it, is without coal; hence this commodity forms 88.7 per cent of the west-bound traffic and more than one-fifth (21.6 per cent) of all freight passing through the Sault Canal. This coal also makes up 59.8 per cent of all domestic coal traffic on the Great Lakes. Since there are many ore boats seeking coal as a return cargo, the Northwest gets its coal cheaper than Chicago, the average rate from Ohio ports to Duluth being 31 cents per ton and to Chicago 41 cents. Although cheap coal has done much to hasten development in northern Minnesota, Wisconsin, and Michigan, thus creating a market for other eastern products, west-bound traffic still forms only one-fourth (24.6 per cent) of Lake Superior commerce. The influence of the iron mines on the development of Great Lakes commerce, therefore, has been a controlling one. They have produced traffic in two commodities—iron ore and coal—which together constitute more than four-fifths (88.3 per cent) of the Sault Canal traffic and more than three-fifths (63.5 per cent) of the total domestic commerce

of all the Great Lakes. While it is impossible to measure the growth resulting indirectly from this development, it undoubtedly has contributed no small amount to lake commerce.

Development of the Carrier. In the development of lake commerce the canoe was followed by the sailboat and the latter by the steamer; wooden vessels gave place to steel vessels, and package freight to bulk freight. If considered individually each has been a revolution, but in the course of development one was essentially the corollary of the other. Lake Superior iron ore has been the primary factor in producing the phenomenal changes in recent years.

More than half the bulk freighters built in 1896 for Lake Superior traffic exceeded 2,000 tons net register, yet six years before there was not a single vessel of that tonnage. This change was made possible by the Canadian canal and the Poe lock in the American canal. Today, vessels carrying 6,000 tons are becoming obsolete, while 10,000 to 12,000 ton boats are increasing rapidly in number. Between 1905 and 1909 twenty-six 13,000 to 14,000 ton freighters entered Lake Superior service. During the past twelve years many 400-foot vessels have been replaced by 400 to 600 footers. In 1919 the average ore cargo was 8,543 gross tons, and boats of more than 500 feet in length, carrying 10,000 to 13,000 short tons of freight in a single cargo, were in use. The modern, single-cargo freighter is a direct result of the necessity of transporting a heavy, bulky commodity nearly a thousand miles at a minimum of cost. Bulk freighters exist for carrying grain and lumber, but they serve only a small percentage of the total traffic of the Lakes.

The iron-ore traffic has changed not only the size of the carrier, but the carrier itself. Wooden vessels now form only about one-third of the gross tonnage of the Lakes, yet they were dominant a few years since. Steel construction has displaced both iron and wood, and a vessel characteristic of the Lakes has been produced. "They are only square boxes whittled off a little at the ends, and not much forward at that. The reason for this is of course the limited draft of water available and the desire to carry as much as possible on that draft." The machinery is far aft and the pilot house is far forward, leaving all the cargo together and the hatches without a break.

Lake Freights. As the freighters were improved the cost of freight carriage decreased. Since cost of transportation, not mileage,

is the true commercial measure of distance, and since steel-making affects the whole nation, this change has been of vital importance. The water route, steel vessels of great capacity, cheap fuel, coal as a return cargo, the Sault Canal, river and harbor improvements, the growing demand for ore, consolidation of management, and the extensive use of modern machinery, all have contributed toward producing the lowest freight rates in the world for similar service.

Development of Shipping Cities. Two classes of ports—shipping and receiving—have developed with the growth of the iron industry. The former are few; the latter are more numerous and widely distributed. These ports dominate lake commerce, all but two of the sixteen principal commercial ports belonging to one or the other of these classes. The chief shipping ports are Marquette, Escanaba, Ashland, Two Harbors, and Duluth-Superior.

Marquette, the outlet for the Marquette Range, is the oldest ore-shipping port, and for many years was the only one of much importance. In 1864 the Chicago & North-western Railroad was completed from Negaunee to Escanaba, where an ore dock was built with pockets having a capacity of 20,000 tons, which unload directly into vessels without shoveling. Escanaba has an excellent natural harbor, has a longer season free from ice than Marquette, and is nearer than the Lake Superior ports to the Lake Erie markets, and has no canal delays. It therefore became an outlet to the Marquette, Menominee, and Gogebic ranges, and its shipments soon surpassed those of Marquette, a position which it retains. Ashland serves as an outlet for the Penokee-Gogebic Range, especially the Wisconsin portion.

When the Vermilion Range was opened that portion of the Lake Superior region was a wilderness, and it was necessary to select a harbor and establish a shipping port on the lake shore. Two Harbors thus came into existence. It was connected with the mines by railroad in 1884, when the first ore was shipped. With the development of the Mesabi Range its ore shipments have grown rapidly. They constitute 99.5 per cent of its domestic commerce and nearly all of its shipments. It depends on the ore trade, and its decline would be rapid if that were withdrawn.

Duluth-Superior would have considerable importance without the iron mines. Its strategic position at the head of Lake Superior, its commodious, landlocked harbor of 360 acres with a minimum

depth of 20 feet and 49 miles of frontage, its rich agricultural hinterland, and its water-power from St. Louis Falls are abundant bases for growth. But with iron ore close at hand, cheap coal in large quantity always available, and an increasing market to the south, west, and northwest, its manufacturing advantages are great.

Development of Receiving Ports. The iron-ore shipping ports are few in number, but the receiving ports are numerous and widely distributed along the Lakes. These ports may be classified as (1) manufacturing and distributing and (2) distributing only. To the first class belong Cleveland, Erie, Buffalo-Tonawanda, Chicago-Gary, Toledo, and Lorain, and to the second class Ashtabula, Conneaut, and Fairport. There are numerous other minor ports belonging to the manufacturing class, the aggregate receipts of which are large, but which need not be considered here. The total domestic commerce of the nine or ten ports named constitutes (1910) nine-tenths (89.6 per cent) of the total domestic commerce of the five Great Lakes. The domestic commerce of the eight Lake Erie ports formed more than nine-tenths (92.4 per cent) of the total for that lake, and their receipts formed nearly half (44 per cent) of the total receipts. The position they occupy in lake commerce is therefore one of great importance. The factors determining their relative importance in the ore and coal traffic, and hence in lake commerce, are many and variable. Among the fundamental ones are (1) policies of railroads and interests of those controlling railroads serving these ports, (2) location of new manufacturing plants and the improvement of the old ones, and (3) harbor advantages.

Manufacturing and Distributing Ports. Only the commercial phase of the manufacturing problem will be considered here. Cleveland, Chicago-Gary, Buffalo-Tonawanda are the leaders of this group. Many things have contributed to the growth of Cleveland, but it was the development of the lake trade which made it a great industrial center. Cleveland is also an important coal-shipping point, and that commodity forms more than four-fifths of its outgoing freight.

Buffalo and Tonawanda occupy strategic positions at the head of Lake Erie, have power for manufacturing equaled by few other American cities, and are certain of a prosperous growth without the iron and steel industry. Yet this district has the largest independent steel-making plant in the United States, and its ore traffic has grown

in twenty-five years from 7,160 tons to 4.3 million tons. Some of this ore is sent farther inland, but most of it is consumed at the ports. It enjoys a large trade in grain as well as in coal and iron ore, yet the last two formed more than three-fifths (61 per cent) of its total domestic commerce in 1910, coal making up 70.4 per cent of the shipments and iron ore 56 per cent of the receipts. It ships nearly 2.5 million tons more hard coal than all the other lake ports combined. The commerce of Lorain is almost entirely (97.5 per cent) ore and coal.

Ore and coal dominate the lake commerce of Erie and Toledo. The ore receipts of the former were 938,000 tons in 1910, and with coal (696,000 tons) constituted three-fourths of its lake traffic. The ore traffic of Toledo formed more than four-fifths (84.3 per cent) of its total receipts.

Chicago, Gary, and Milwaukee are the only important ore-receiving ports on Lake Michigan. They are almost exclusively manufacturing points, so far as iron ore is concerned. The Chicago-Gary region occupies a strategic position near the head of the Lake, has excellent land transportation to a rapidly growing market, and is near coal and limestone. Owing to the methods of railroad companies, legitimate and otherwise, the lake commerce of this district is not commensurate with its advantages. If its ore traffic were to cease it would lose 56.8 per cent of its total lake commerce and would retain less than one-third (30.4 per cent) of its receipts by water. These facts emphasize the importance of the Lake Superior ores to the Chicago-Gary region.

Distributing Ports. Ashtabula is the largest ore-receiving and coal-shipping port in America, and probably in the world. It receives ore for distribution only, and the growth of its receipts in twenty-five years, from 582,000 tons to 9.6 million tons, is therefore all the more remarkable. Ore forms almost all (99.9 per cent) of its receipts and coal more than nine-tenths (93.5 per cent) of its shipments. It has excellent rail connections with the coal and smelting districts of western Pennsylvania and eastern Ohio and harbor facilities unexcelled by any of its competitors. The harbor advantages have given it prestige. Without ore and coal, Ashtabula probably would become an insignificant village.

Conneaut, like Ashtabula, Fairport, and Huron, is a distributing point, and exists largely or wholly because of the ore which comes from

the Lake Superior mines. It has good harbor facilities and is the terminus of the Bessemer & Lake Erie Railroad, controlled by the United States Steel Corporation. Since that corporation is the largest shipper of ore, Conneaut rose in ten years from an insignificant place to the third largest receiving port on the Lakes. Fairport has a good harbor, and the Baltimore & Ohio Railroad connects it with the Youngstown-Pittsburgh district. Its ore receipts and relatively small coal shipments form three-fourths (75.3 per cent) of its commerce.

Destination of Lake Superior Ores. After passing the Sault Canal, about one-seventh of the ore from Lake Superior fields enters Lake

TABLE XXXII

SHIPMENTS AND RECEIPTS OF IRON ORE ON THE GREAT LAKES

(GROSS TONS, 000 OMITTED)

Shipping Ports	1914	1916	1919	Receiving Ports	1914	1916	1919
Escanaba	3,660	7,460	4,960	Detroit	330	430	550
Marquette	1,760	3,860	2,130	Toledo	770	2,040	1,540
Ashland	3,360	8,060	5,920	Huron	620	1,320	1,130
Superior	11,310	12,790	10,920	Lorain	1,680	4,610	3,380
Duluth	6,320	21,840	16,820	Cleveland	5,520	10,670	7,470
Two Harbors	5,610	10,740	6,420	Fairport	1,560	2,580	1,950
				Ashtabula	5,320	11,470	8,380
Total	32,020	64,730	47,180	Conneaut	6,260	9,590	7,060
				Erie	260	1,530	1,100
				Buffalo	2,910	7,430	4,650
				Port Colborne	170	140	220
				Total Lake Erie	25,400	51,810	37,420
				South Chicago	3,060	7,740	4,670
				East Jordan	40	40	30
				Boyne City	50	40	50
				Elk Rapids	30	....	....
				Milwaukee	90	240	130
				Indiana Harbor	660	790	1,150
				Gary	1,630	2,720	2,510
				Total Lake Michigan	6,110	11,570	8,540

Michigan, and nearly all the balance, or approximately 30,000,000 long tons, goes to Lake Erie ports. From these ports most of it is carried to the Youngstown-Pittsburgh district. Millions of tons are carried several hundred miles farther, however, to eastern Pennsylvania, Virginia, and Ohio River points, and for special purposes to New England. In addition to water-borne ore, considerable quantities are shipped by rail to furnaces within convenient distances from the mines and to points to which an all-rail haul is more economical than breaking bulk from vessels. Such points are

St. Louis, Missouri, and Mayville, Wisconsin. Tables XXXII and XXXIII supplement the information given in Mr. Miller's article.[1]

TABLE XXXIII

SHIPMENTS AND RECEIPTS OF COAL AT LEADING LAKE PORTS IN 1916

(Short Tons)

Shipping Ports	Tons	Receiving Ports	Tons
Toledo, Ohio	6,800,000	Duluth-Superior	9,500,000
Ashtabula, Ohio	4,400,000	Milwaukee, Wis.	5,300,000
Lorain, Ohio	3,100,000	Chicago–South Chicago, Ill.	1,600,000
Buffalo, N.Y.	2,900,000	Hancock-Houghton, Mich	1,200,000
Cleveland, Ohio	2,600,000	Sault Ste, Marie	1,000,000
Sandusky, Ohio	2,600,000	Ashland, Wis.	800,000
Erie, Penn.	1,700,000	Sheboygan, Wis.	600,000
Conneaut, Ohio	1,400,000	Green Bay, Wis.	600,000
Huron, Ohio	1,000,000	Manitowoc, Wis.	600,000
Charlotte, N.Y	1,000,000	Escanaba, Mich.	500,000
Total (including all others)	30,179,847	Total (including all others)	30,179,847

6. FACTORS IN THE ESTABLISHMENT OF THE CATTLE MARKETS[2]

The so-called "corn-belt" states—Ohio, Indiana, Illinois, Iowa, Missouri, Nebraska, and Kansas—have about one-third of the cattle other than milch cows in the United States, but they respresent more than one-third the value of such cattle in the country. In addition to the cattle regularly enumerated, upon which the preceding statement is based, we must consider the hundreds of thousands of feeding cattle that are annually brought into the corn belt to be fattened. Including this supply of cattle, and considering their quality and value, perhaps one-half the beef-producing industry of the country is centered in the seven states mentioned.

It is interesting to note that while more than two-thirds of the cattle in the United States in 1910 were west of the Mississippi River, more than two-thirds of the population of the United States was in states east of the Mississippi. In 1880, 78 per cent of the population was east and more than one-half (about 55 per cent) of the cattle west of the Mississippi.

[1] Table XXXII is adapted from *The Marine Review*, February, 1920, p. 96; Table XXXIII from *Transportation by Water*, Bureau of Census, 1916, p. 146. Most of the coal shipped from Buffalo is anthracite; Erie is the only other lake port shipping anthracite.

[2] Adapted from H. W. Mumford and L. D. Hall, "A Review of Beef Production in the United States," *University of Illinois Agricultural Experiment Station, Circular No. 169*, 1913, pp. 13–17.

Another striking comparison is that of the manufacturing and the non-manufacturing sections of the United States. At the time of the last census, more than one-half of the population was found in less than one-seventh of the area of the country, viz., the states east of the Mississippi and north of the Ohio and Potomac rivers. This portion of the country produces more than three-fourths of our manufactured products, pays more than four-fifths of all salaries and wages, and contains more than two-thirds of the assessed value of all real and personal property. It is therefore the great consuming area of the country; but (east of Chicago) it has less than one-eighth of the beef cattle and less than one-fifth of all cattle of the United States. In other words, seven-eighths of the beef cattle and four-fifths of all cattle are produced west and south (principally west) of the manufacturing district. Consequently, there has been an enormous movement of cattle from west to east to supply the demand for beef in the more densely populated sections. This has brought about the establishment of the great cattle markets at Chicago, Kansas City, St. Louis, Omaha, St. Joseph, Sioux City, and South St. Paul.

Development of the Great Cattle Markets. A study of the growth of the important market centers sheds much light on the development of the cattle-raising industry of the country. Comparing the annual receipts, in round numbers, at ten-year intervals since 1880, we have the summary given in the following table. (The markets are arranged in the order of receipts for 1910.)

A study of these market records shows clearly the extent to which western slaughtering has replaced the shipment of live cattle to eastern cities. The markets at Chicago, Missouri River points, St. Paul, Fort Worth, and Denver have grown rapidly, while a number of eastern markets (e.g., Buffalo and Pittsburgh) show a marked falling off.

The recent development of the far western markets, Denver and Fort Worth, is especially noteworthy. Large markets are also being developed at Seattle, Portland (Oregon), and San Francisco which will contribute still further toward local slaughter in the West and thereby diminish the relative number of live cattle shipped eastward. Chief among the factors that have brought about this great movement are railroad development, the refrigerator car, and the tin can.

Along with better facilities for shipping live cattle came improved methods for transporting dressed beef and beef products. The invention of the refrigerator car in 1868 made it possible to slaughter cattle in the West and ship the dressed beef to the large eastern cities and to Europe. Thus the fresh-meat trade extended over the summer season as well as the four cold months to which it had been previously confined. This invention greatly reduced the cost of

TABLE XXXIV

NUMBER OF CATTLE RECEIVED AT LARGE MARKETS, 1880 TO 1910*

Market	1880	1890	1900	1910
Chicago	1,382,000	3,484,000	2,729,000	3,053,000
Kansas City	245,000	1,472,000	1,970,000	2,230,000
Omaha	87,000	607,000	828,000	1,223,000
St. Louis	346,000	511,000	698,000	1,207,000
Fort Worth	....	....	90,000	785,000
New York	683,000	674,000	630,000	615,000
St. Joseph	....	28,000	380,000	510,000
St. Paul	32,000	93,000	176,000	482,000
Sioux City	55,000	167,000	300,000	411,000
Denver	54,000	114,000	240,000	383,000
Indianapolis	133,000	120,000	140,000	309,000
Cincinnati	189,000	172,000	177,000	257,000
Buffalo	....	....	654,000	220,000
Pittsburgh	....	....	251,000	150,000
Baltimore	....	....	163,000	142,000
Philadelphia	....	....	165,000	....
Jersey City	....	....	228,000	....
Boston	227,000	168,000	178,000	128,000
Louisville	....	....	94,000	126,000
Portland, Ore	....	....	....	90,000
Seattle	....	10,000	19,000	55,000

* Calves not included.

NOTE.—Omissions in this table are due to the fact that statistics were not obtainable, either because a market had not been established or because no records were kept.

transportation besides making it possible for the packers to operate throughout the entire year. For example, from Chicago to New York in 1908 the freight and other expenses of the road on an export steer of average weight (1,250 pounds) varied from $4 to $4.40, while the freight on the carcass of the same animal (700 pounds) was only $3.15, not including the expense of icing. From Kansas City to New York the difference between live and dead freight was still greater, amounting possibly to $2.25 or $2.50 per head. The total

cost of shipping a live steer from Chicago to Liverpool, including freight, feed, and attendance, is estimated to have been $13.60 to $16.70, or considerably more than double the cost of shipping the average weight of fresh beef yielded by the animal.

Fresh beef was first shipped in a refrigerator car from Chicago to Boston in September, 1869, but it was not until 1875 that this system became well developed. About the same time, the tin can was introduced into the meat-packing industry and it contributed still further to the successful shipment of beef products to markets in distant parts of the world. The utilization of previously wasted by-products for the manufacture of valuable products also began to receive close attention. These factors, together with the settlement and extension of the cattle-producing regions of the West, the building of railroads, and the development of agriculture and industry in general, combined to mark the most important turning-point in the annals of American beef production.

7. THE ECONOMIC PROBLEM OF THE OZARK HIGHLAND[1]

The term Ozark associates a group of regions possessed of widely divergent characteristics. Simplicity and similarity are hardly more representative of the Ozark areas than they are of the regions grouped together under the term Appalachian. In the Missouri Ozarks eight distinct divisions must be recognized, and for Arkansas at least two more are to be added. It becomes a matter of more than ordinary difficulty, therefore, to speak of conditions and problems in the Ozark Highland as a whole. Yet there must be an adequate geographic unity, otherwise popular usage, unbiased in this case by common political traditions, would not have set up this regional designation.

(1) The Ozark areas constitute a compact highland, for the most part notably elevated above the adjacent areas. This is the common factor in the topography, and for this reason no more precise term than highland can be employed appropriately in a geographic sense. In the interior the highland consists of a remnant plateau area, broken into long shreds by stream dissection. Except on the west, hill belts, of very difficult character, surround the central region.

[1] Taken from Carl O. Sauer, "The Economic Problem of the Ozark Highland," *The Scientific Monthly*, September, 1920, pp. 215–27. Mr. Sauer is associate professor of geography at the University of Michigan.

The outer flanks of the hill regions, with the exception of the southern and southeastern portions of the highland, are adjoined by less rough border areas of superior resources and development. (2) Even in the Ozark areas of least relief there is more rough land than in adjacent regions which usage does not place in the highland. (3) Ridges and valleys are sharply differentiated. The topography is dominantly of the ridge-and-valley type. (4) Most of the area has been sculptured out of limestone by streams, with the abundant aid of underground solution. A close genetic relationship exists between the widely distributed sinks, caverns, springs, and the lead ore, iron ore, and other mineral deposits. (5) A significant property of the Ozarks is the almost universal distribution of chert fragments over the surface. These produce similar effects on slopes, soils, stream beds, and on agricultural practices and road-making. Such in the main are the common qualities that are opposed to the multitude of differentiating conditions.

In the following pages the attempt is made to determine whether there exists also a common economic problem for the area as a whole. The inquiry is concerned chiefly with the heart of the Ozarks, namely, with the central plateau and its surrounding hill areas. Just as popular usage is uncertain regarding the inclusion of the border areas in the highland, so the economic conditions of the borders are only in limited degree typical of the area as a whole, and the generalizations that follow can be applied to such regions as the Springfield, Missouri River, and Mississippi River borders only with important reservations and exceptions.

The most common conception current regarding the economic character of the Ozark region is its inferiority to the regions that lie about it. The idea is substantially correct and may be demonstrated statistically in many ways by the values and amounts of crops and of other products which the area yields. These facts appear to register the adjustment of a group to an inferior environment. This is true in part, but it does not fully account for the economic situation. There still remains to be considered the question whether the Ozarks are underdeveloped relative to such resources as are available under present economic conditions. In particular it is necessary to inquire whether the economic adjustment is to the present or to a previous value of the environment, for the environment is not necessarily a static

factor uninfluenced by the passage of time and the changes in opportunities of production. The case to be examined concerns the possibility of an original adjustment which has since been revised insufficiently, with the result that the Ozark Highland has fallen behind seriously in the progress that may be expected of it, making all due allowances for thin soils, steep slopes, and other handicaps.

When settlement west of the Mississippi River began the flanks of the Ozarks were preferred to all other territory in upper Louisiana. This preference continued beyond the time when Missouri and Arkansas were admitted to statehood, and was based on the variety and balance of the local resources rather than on the large amount of any one resource. It was the possibility of sufficiency and especially of self-sufficiency that caused to be located in this area the first American settlements west of the Mississippi. When transportation facilities made commercial production possible in the West, farm immigration was diverted to other areas. The true pioneersman, however, not intent on producing a surplus of crops for sale, was able to occupy step by step the whole of the Ozarks, conscious of no deterioration of his environment as he penetrated into areas of longer and steeper hills. For was there not everywhere good hunting and fishing, excellent water, grazing for his horses and cattle, mast for the hogs, and patches of bottom land for corn, beans, and pumpkins? Here he could meet his own needs of lead and gunpowder, dig his iron ore and smelt it, and have ample power for his grist and carding mills. Frontiersmen, rather than agriculturists, became the permanent occupants of the area. With the filling up of adjacent regions, the Ozarks became a sort of refuge to the men who clung to frontier life. After a fashion the frontier still lingers in the Ozarks, but the unconstructive character of frontier living and the increase of population have gradually caused the disappearance of some of the more agreeable features of this life. For an understanding of the area it is essential to keep in mind its antecedents, and also that the blood of the frontiersman is still dominant among the population.

At present, the Ozarks contain somewhat less than 30 per cent of the population of Missouri, resident on approximately half the area of the state. Since a full third of the people of Missouri live in St. Louis and Kansas City, the population of the Ozarks is nearly of the same density as in the rest of rural Missouri. The situation

in Arkansas is similar. Whereas immigrants have not been numerous, serious loss by emigration began later than in other nearby rural districts. Population had not increased to the limit for the food supply under the methods of production practiced, and the world outside was little known. The last census, in 1910, was the first to record declining numbers over widespread areas. In the beginning of the new century, rural free delivery of mail became generally established and a serious blow was dealt thereby to the old isolation that had kept people at home. The effects of the late war probably will be even more far-reaching. In 1917 the government placarded the most remote post-offices with calls for workers in war industries and offered the opportunity of rendering a service to the nation and of securing wages of a magnitude unheard of in this country where wages for the most part have been nominal. Large numbers left for the cities of Illinois and northern Missouri and for the mining and oil fields. The draft took thousands of young men away from home for the first time, and introduced them to new standards and modes of life. Many are not returning. The great prosperity that is continuing through the country has found only a weak echo in the hills of the Ozarks and additional workers are still leaving to share in the high wages outside. The past five years, therefore, have seen a critical increase in the emigration. The old contentment with the simple home in the hills was based in part on a lack of knowledge of outside conditions. A world-catastrophe has supplied this knowledge. The selective elimination of the more ambitious of the younger generation is in full progress.

Under these circumstances attempts by railroad immigration officials and state bureaus to direct immigrants into the Ozarks are misplaced. If any effort is worth while it must be concerned with retaining the native population. Relative to developed resources the highland is more densely settled than its neighboring areas, and largely in consequence labor commands lower returns. Emigration is natural and inevitable as long as it is directed by economic pressure as at present. The better sons of the Ozarks can find it worth their while to remain only if defects in the present economic adjustment are found and remedied. If nothing of the sort happens, the drainage of this best blood will continue permanently and will express itself in the decreased productivity of the area. The movement is only in

slight measure similar to the release of a portion of the population by improved methods of production such as has been the case with power farming in the prairie states. The emigration now in progress indicates the beginning of actual economic decline in numerous sections, if not yet generally.

It does not follow from the foregoing that the people of the Ozarks live in want. An initial period of no inferiority has been succeeded by a century in which contrasts with surrounding regions have grown sharper and less favorable. The consciousness of such an unfavorable comparison is in the main a matter of recent growth. The drifting away of the most productive part of the population is following naturally and constitutes a threat of increasing seriousness.

The half of Missouri that lies in the Ozarks possesses less than one-sixth of the wealth of the state. In terms of population, however, the situation is much more favorable. Valuations returned by the State Board of Equalization for 1918 are approximately $320 per capita for the Ozarks, as against 575 dollars for the entire state. In this calculation there are included in the Ozarks such prosperous centers as Springfield, Jefferson City, and Cape Girardeau, as well as the mining regions of Joplin and the St. Francois district. On the other hand, the largest area of rough hill country in Missouri, embracing a half-dozen counties of extremely low total valuations, shows per capita valuations nearly equal to the average of the whole Ozark Highland. Two of the roughest counties in the Ozarks exceed the per capita average of the Ozarks by one-eighth. The explanation is that in the rough hill areas the hills are almost entirely non-agricultural and the population is concentrated on reasonably good valley lands. Also, in a comparison of the Ozarks with the remainder of Missouri it must be remembered that St. Louis holds a full third of the wealth of the state, and that St. Louis and Kansas City together account for nearly one-half of all property. According to per capita of population, the valuation of the Ozark region is easily two-thirds that of the remainder of Missouri if the two principal cities are eliminated. Certainly no general condition of poverty prevails.

If the region gives an impression of poverty to the casual visitor the explanation must be found in the simplicity of the habits of the people and in the even distribution of wealth. Few men possess much more than their neighbors, but want is not much more common

than is wealth. There are a few poverty spots on submarginal farming lands, which are not in the supposedly poorest regions, the rough hill sections. Too much emphasis has been given to the idea of poverty in the Ozarks. The parallel between the living conditions of the Ozark native and the mountaineer of Kentucky and Tennessee is not at all close, and even less so is that with the poor white of the southern Coast Plain. A degrading environment can be shown only for very limited tracts and these are for the most part outside of the cherty limestone regions. The trouble lies in the stagnation of life, as expressed by the lack of development of new opportunities, and in part in an incipient contraction of standards of living because an outworn economic system is still followed.

The economic system has been altered only in minor ways from that which was in force at the time of early settlement. The average inhabitant of the Ozarks is still an unspecialized small farmer rather than a farmer following an intelligent practice of diversification. Of labor income he knows nothing, and commonly has none. The pursuits which he follows give little opportunity for the accumulation of a surplus. The aim of labor is hardly commercial, the labor being expended directly toward the sustenance of the family. The condition is characteristic of primitive groups. The economy is based primarily on agriculture, but agriculture is typically only a partial means of subsistence.

Corn is the dominant crop. It is grown on thin uplands and on stony hillsides as predominantly as it is in rich bottoms. It is produced not only with almost total disregard of the character of farming land, but of the size of yield as well, simply because it has a larger direct utility to the individual farmer than any other crop. It feeds the family, and the horses, cattle, and hogs. It will keep without means of storage. It will grow in the most poorly prepared ground. It yields the largest returns of food per acre cultivated. Also, it was grown by the first settlers as the main crop and their descendants are following the old traditions. From the standpoint of commercial development, from every standpoint, in fact, except that of a farm functioning as a self-sufficing unit, corn is grown very much in excess of the best interests of the region. Except in the bottoms, the land has been much too heavily "corned" for years and increasing difficulty is experienced in maintaining yields. But from the highly indi-

vidualistic viewpoint of the native it is the most suitable crop for his social system or the lack of such a system.

In addition to being a corn farmer, the resident of the interior Ozarks is normally a live-stock producer. He could not be designated, however, a rancher, breeder, or feeder. The form of the industry also goes back to first frontier, and was responsible in large measure for pioneer immigration into the Ozarks. The plateau shreds, even where they were only narrow ridge tops, were covered originally with grasses. They are still commonly called prairies. On these live-stock grazing was instituted at an early date. Fires were set habitually by the pioneers to replenish and extend the grazing lands. These fires extended the grass lands at the expense of the forests. Grazing itself extended into the forests as the population increased. Fires and long-continued grazing in the forests have interfered in many districts with the growth of seedlings, sprouts, and other undergrowth, and have resulted in a forest floor covered with grass and weeds. The ridge tops are now converted almost entirely to plowland, and grazing has therefore suffered a restriction to the forested areas, which are nearly equivalent to the hillsides. This poor, volunteer pasturage among the trees is incapable of improvement and by reason of long-continued grazing at all seasons has been steadily deteriorating. With the elimination of the natural grass lands the cattle industry has largely passed into the condition of a relict industry.

Hogs fare much better, being essentially forest animals and finding here a varied and often good mast of acorns, nuts, berries, and roots. The razor-back animal is an unimproved but successful adaptation to his peculiar environment. Sheep are very few, because, roaming at will, they are subject to serious danger from dogs, who are also unrestrained. Turkeys thrive under a similar life, in which they partially revert to an undomesticated condition.

The keeping of stock bears virtually no relation to the ownership of land. All land that is not farmed or in fenced pastures constitutes the free range. This consists in part of large timbered holdings belonging to absentee owners. Many large tracts are crossed by the property lines of local farmers but are not shut off by fences. The result is that stock ranges widely through the woods for most of the year without attention. As a consequence the struggle for a bare

existence keeps it in poor flesh. Even more serious is the reproduction by accidental breeding from scrub sires. Against the ease of this method of live-stock raising are to be set the very low quality of the product, the decreasing carrying power of the range, and the uncertainty of the returns.

The average farm contains more wooded land than it does cleared land. This is true even of the border regions, with the exception of the Springfield area. In the hill counties there are likely to be three or four acres of timbered land for every acre cleared, in each farm. In addition, there are large timber tracts that are not included in farms. Timber products, therefore, are an important item in the economy of the native. These items are produced and marketed principally by the farming population, not by lumbermen. The principal products are ties, and in some localities cord wood and mine props. The important stands of white and post oak are especially valuable for ties, of which the aggregate production is large. The principal winter occupation is the cutting and hewing of ties. They are then hauled out over the frozen roads, or later rafted downstream during freshets. The industry is pursued with particular zeal because, among a group of part-time occupations that yield little for sale, it provides cash returns. The very great increase in the price of ties has lately stimulated strongly the search for suitable tie timber. There are few sections in which the trees available for this purpose are not fast decreasing, and the cutting of such timber has proceeded into the most remote localities.

Numerous minor and incidental occupations are followed also for their cash returns or for purposes of barter at the country stores. Here belong the digging of roots such as ginseng, golden seal, and blood root, hunting and trapping for skins, and the digging of minor minerals, such as tiff (baryte) and fire clay. In most cases, increased prices have made good a decreasing supply, but the supply of these auxiliary resources is in general markedly declining.

The Ozark farmer, in short, is following a system of production that is in reality simply exploitation. In virtually all of his occupations he has passed the period of largest-volume returns, although aggregate values may still be mounting. Increased prices cannot permanently resist the actual decline that is threatening the productive efficiency of the individual. Exploitation is a mark of the

frontier, and the perpetuation of the frontier is recorded strikingly in this general condition.

The reasons for this peculiar fixation of a frontier are not difficult to determine. In the first place, to a degree not equaled elsewhere in the Middle West, the people of the Ozarks are descended from frontiersmen. The parent-stock represents a certain aversion to orderly and sustained endeavor and therefore to intensive production. To what extent the trait persists as a hereditary quality is not known, but, given the opportunity, the native of the Ozarks appears to be about as frequently successful as most other Missourians or Arkansans. The difficulty with his ancestry seems to lie not so much with physical inheritance as with the traditions among which he is brought up. At the least, he has not inherited the agricultural experience and interests with which his neighbors of the plains are surrounded. He goes back to a more primitive ancestry.

The biggest element in the retardation of Ozark life is the isolation that the surface has imposed on the inhabitants. A chain of rugged hill regions is thrown about the interior plateau and constitutes a veritable entanglement of obstacles against any approach from the lines of communications that follow the Missouri, Mississippi, and Arkansas rivers. Even more significant than the exclusion of the outside world is the detached manner of living of the people. Valley is separated from valley; valley settlement is out of touch with ridge settlement; often family is isolated from family.

The simple result is that the isolation has kept social and economic progress at a snail's pace. The people were primitive in their condition when they came, they are nearly as primitive now. Without strong social instincts and training to begin with, how were they to achieve common interests, common opinion, and common effort? For the economic problem of the Ozark Highland is after all social in its fundamentals. The difficulty that the people experience in getting to market is less serious than their failure to get together. There has been no substantial economic development because topographic isolation has maintained successfully the social anarchy of the frontier. It is the solitary position of the individual, rather than the poverty of the soil, that at bottom is at fault with the Ozarks. The so-called political conservatism of the Ozarks is well known. It has its full social and economic equivalents. The individualism is almost

static. The individual produced under this system is bound down by it. How can he be intelligent enough or sufficiently strong to reshape the outworn economic order? There are adequate possibilities for the inhabitants of the Ozarks, but these can be realized only by fairly advanced co-operative effort. Of co-operation the native knows nothing beyond the relief of a neighbor in trouble. The stakes of the region are not such as to tempt extraneous capital, and the social order, therefore, has received no alteration from the outside. Unless the region is to become decadent, the isolation and its resultant excessive individualism must be broken down, and this must be done by the governments among which the highland is divided.

The first corrective measure must be improved means of communication. The construction of additional railroad lines on the long shreds of plateaus is a simple matter. However, their returns for a considerable period would hardly be sufficient to tempt private capital. Unfortunately, also, several Ozark branch lines have been abandoned lately. Similar experiences in other sections of the country indicate that the time is probably past for the construction of branch-line railroads.

The main wagon roads follow ridge tops. Their location is determined by low cost, freedom from floods, and freedom from erosion. They are passable throughout the year, but serve directly only the settlements on the ridges. Over large sections these settlements are not as flourishing nor as promising for future developments as the valley settlements. It is notorious that the traveler on the main roads sees very little of the better land. The ridge roads are separated from the valley farms by steep hills. Connection between the two is made by rough and often badly washed side roads. The secondary roads that follow the valleys are subject to flooding with every freshet and are often washed out. Fords are innumerable, bridges few. The location of roads was determined by the easiest lines of travel. The adjustment is complete so far as it goes, but it is based on unimproved roads that are simply traces worn by travel. Permanent roads are needed in the valleys. Their appropriate position would be on the lower flanks of valley slopes out of reach of floods. Roads of this type can be had only by moderately costly construction.

The road situation is so bad that it is almost impossible, and consequently a number of counties are now undertaking road-building by bond issues. The present policy of state aid is contributing important funds indirectly from the wealthier portions to those Ozark districts that desire to avail themselves of help. There is an unfortunate tendency, however, to follow the locations of roads as they have become fixed by pioneer custom and to superimpose the improved road on the all-weather trail. In the building of roads there is needed not merely the technical skill of the road engineer, but a close economic analysis of the distribution of good farming districts and their relation to road facilities.

The live-stock industry as a co-operative enterprise, in place of its present individualistic form, is indicated as the dominant ideal occupation of the future. (1) Partly as the result of the long period of erosion, partly because of the powerful aid of solution, valley bottoms are extraordinarily numerous and large, even among the roughest hills. Their rich soils, annually reinvigorated by floods, are suited to continuous cropping to corn. The only argument for rotation of crops on these lands is the elimination of diseases of the corn plant that may find lodgment in the ground. On the valley lands, soy beans, velvet beans, cow peas, clover, and alfalfa also grow very well. These lands may grow important quantities of high-grade stock feed. (2) Cheap grazing lands are available in large amount. The lower valley slopes, the slip-off slopes of intrenched meanders, benches on the sides of valleys, and the smaller ridge tops especially are well suited for hay and pasture. Many ridge lands are being cropped that should not be under plow. Their thin clay soils are unprofitable for grain-growing, but will produce good grass, as they once did. In connection with a really profitable live-stock industry these ridge lands would be employed most profitably as permanent grass lands. At present the most indigent larger group of farmers in the Ozarks is found on ridges of this type. Very valuable forage grasses and clovers are in process of naturalizing themselves successfully, and with some protection will improve the quality of the forage markedly. It is to be remembered that the strikingly poor quality of present pastures is the result of overgrazing and utter lack of care. (3) The mild climate and abundant rainfall extend the grazing season almost to nine months. Woods, cliffs, and coves provide

partial winter shelters, too often the only ones supplied for the stock. Housing and winter feeding, however, are not serious problems. (4) Probably no other section of the United States is so well supplied with springs. Throughout the limestone country magnificent springs of cold and pure water abound along all valleys. The assertion is often made by a farmer that he has a good spring in each pasture.

Cattle, hogs, and sheep all have their place on the Ozark farm. (1) The first step in improvement of conditions is also the easiest. It consists in the elimination of undesirable sires. Even this is a community enterprise, as to both the purchase of pure-bred males and the disposal of the undesirable males. The custom of allowing stock to range about in the forests is not likely to disappear soon, nor is it necessary if the control mentioned is exercised. (2) The Ozarks constitute potentially a great dairy country, undeveloped at present except for certain border regions. The absence of dairying is due to the serious difficulties in marketing and the utter lack of experience of the people. Cheese making is largely independent of shipping facilities and could be undertaken even in remote valleys. A geographical parallel is to be found in the Carolina Mountains, the physical conditions being somewhat better in the Ozarks. In remote Carolina valleys a remarkable success has been scored in the past few years by co-operative cheese factories. The conditions of living in many an Ozark valley could be transformed similarly under proper direction. (3) A successful swine husbandry could be worked out by combining farm crops with mast and introducing a suitable breed, as for instance one of the forest-bred English varieties of bacon hogs. No attention is being given to the preservation and increase of the kinds of trees that are most productive of mast, for exploitation does not heed any demand except that of an immediate profit, even if small.

For every acre in the Ozark that is in any way improved there remain two acres in the woods. In that third which is classed as improved land is included a good deal of rough, stumpy pasturage with a partial stand of timber remaining. In the hill regions the amount of improved land is very small. It is least in Carter County, with only 9 per cent of its total surface improved. The wild land for the most part is covered with oak timber, cut over repeatedly. The majority of the timber today is small, and where grazing has not

been heavy the second growth is dense. Potentially, it is one of the two most important stands of oak timber in the United States. The removal of the older trees and the neglect and injury of the second growth are resulting in rapid deterioration. In many places even the acorn mast has been destroyed by the cutting of seed trees. Grazing has done much injury to the forest floor, with the result that the growth is less vigorous than climate and soil would indicate. The good timber is nearly gone, but the land on which it grows is essentially non-agricultural. Little of it has been laid waste by fires. It is probably no exaggeration to estimate that fully half of the Ozarks can never be good for anything except the growth of trees. It is not growing good trees now and soon will be virtually non-productive. Missouri is facing the idleness of a fourth of its total area without so much as a forestry office in the state to take notice of the situation. Arkansas is in no better condition. The problem of restoring these forests to a productive condition must be worked out in co-operation with the farmers who own a good half of the forest land and who will continue to be dependent in various important ways on forest products.

As yet there has been surprisingly little soil destruction in the Ozarks. Many Ozark streams are quite clear, even in flood. Gradually land clearing is pushing into the margins of the "breaks" with no profit to the farmer and with the threat of grave damage to the countryside. These dangerous clearings for the most part are made by ridge farmers who need additional acreage and are taking a chance on the upper slopes of the valleys. The clean cutting of timber, fortunately, has not been much practiced, as it is of no advantage to the farmer. Land clearing has nearly reached the limit of safety, and will shortly pass it unless the economy of the area is readjusted. The states concerned are still in good season for the introduction of a land policy that will save the forests and their water power, protect farming development, and relieve the taxpayers from the burden of supporting large areas of idle lands.

Roads, live stock, and a forest policy point the solution to the stagnation of Ozark life. There will be other forms of development, which even now are under way, but these three are the fundamentals. Water-power will be developed in increasing amounts, but its benefits will go primarily to the cities that are situated about the Ozarks.

Tourists will discover increasingly the merits of a recreation in Ozark streams, but it is to be hoped that the native will not have his simple hospitality spoiled by summer visitors. Fruit-growing has received much publicity and there are a number of good, established fruit districts. Elsewhere, shipping facilities and organization present difficult problems. Thin soils and steep slopes are antagonistic to permanent orcharding. Missouri possesses in her loess lands a much more productive fruit soil, much better located than the interior Ozarks, and developed for orcharding to only a very small extent. It would probably be beneficial to the development of the Ozarks to place relatively less emphasis on the possibilities of fruit.

Help is needed for the Ozarks. The condition of the people is such that they cannot well help themselves. They are standing singly, uninstructed in their larger possibilities. It is a numerous population that needs to be made more effective, before degenerative selection destroys its best capacities. State investigators here and there are carrying on inquiries into Ozark problems, but the work is largely lost because advice is given in the main to those who know how to call for it. What is needed above all is a policy of development for the region as a whole which will recognize the unity of the problem, not its fragments. If the states involved have the patience and the wit to plant the community spirit in the valleys and on the ridges of the Ozarks, the native will find in himself and in his environment the resources with which to develop a permanent constructive economy in place of the present self-destructive system handed down from frontier ancestors.

8. AGRICULTURE OF SOUTH DAKOTA[1]

A large majority of the people in South Dakota are engaged in agriculture. In 1910 only 13.1 per cent of the entire population of the state resided in cities and towns having a population of 2,500 or more, and in 1900 only 10.2 per cent. At the taking of the 1910 census more than 60 per cent of the dwellings were on the 77,644 farms of the state. There were only 5,226 persons engaged in manufacturing,

[1] Adapted from S. S. Visher, "The Geography of South Dakota," *South Dakota State Geological and Natural History Survey, Bulletin 8*, pp. 115–24. Mr. Visher is associate professor of Geography, University of Indiana.

and only 4,169 persons engaged in mining, quarrying, and well-drilling. These industries employed less than 5 per cent of the 197,000 males of eighteen years and over. The percentage engaged in commerce and transportation probably is larger than that, but the figure is not available. It appears likely, however, that more than 75 per cent of the workers of South Dakota are engaged in agricultural and pastoral pursuits.

Farming and stock-raising are the leading occupations, largely because of geographic conditions. The wide extent of nearly level, fertile plains, grass-covered, and ready for the plow, and fairly well warmed and watered, encouraged agriculture.

The leading types of agriculture (extensive farming of staple cereals and stock-raising) and the kinds of crops grown are responses to geographic conditions. The position of the state, far from the chief markets for the produce, and in a vast area having similar climatic and soil conditions, small local markets, and without quick transportation to distant markets, discouraged market gardening or the growing of fancy crops. The climate is unfavorable to horticulture, in comparison with that of many other regions. The uncertainty of the rainfall, the scanty population, and the cheapness of land combine to discourage intensive agriculture. On the other hand, the climate, topography, soil, and native vegetation are all relatively favorable to the grazing industry and to the growing of certain standard crops, notably wheat, oats, corn, and hay.

Stock-Raising. From the first settlement of the state, a major part of its used area has been devoted to stock-raising. The nutritious native grasses, cured to hay during the dry autumns, and the light snowfall during most winters always will favor this industry. Formerly the presence of much unsettled land, and the ability of stock to travel many miles to market or to shipping-points gave grazing a great advantage over farming, the farmer finding vast unsettled stretches of country a menace because of prairie fires and locusts. The cost of transporting crops long distances in many cases was prohibitive or greatly reduced the profit. Because of the variable and uncertain rainfall in most parts of the state, mixed farming, in which stock-raising formed a prominent part, has proved more profitable than either cereal farming or stock-raising alone. Consequently there continue to be great numbers of stock in South Dakota.

9. RELATION OF PHYSICAL ENVIRONMENT TO THE AGRICULTURAL INDUSTRIES OF THE GREAT PLAINS[1]

The physiographic province known as the Great Plains consists of vast grassy plains and plateaus sloping eastward from the Rocky Mountains. The topography varies from that of almost level plains to rugged, broken country such as the Bad Lands. The deeper-lying formations antedate the Rocky Mountain uplift and consist of ancient deposits of sedimentary rock. The surface formations, except where they have been removed by erosion, are made up of sediments brought by streams from the elevated region to the west and deposited in fanlike aprons over the Plains. There is an eastward slope in the whole of the Great Plains region which is due partly to the position of the underlying rock and partly to the natural slope of the constructional surface of the ancient fanlike aprons. In western Nebraska the eastward inclination is at an average rate of nearly 12 feet per mile, descending from an altitude of more than 5,300 feet in the western part to about 1,600 feet in the east, but the rate of inclination is more rapid in the west.

The region is composed of strata of varying degrees of hardness and greater or less resistance to erosion, in which the present relief, comprising all variations of topography from nearly level plains to rugged buttes and canyons, has been developed by dissection over the surface of loosened material by the agencies of wind and water. In Nebraska, wind has been a more active agent of soil formation than water, and the vast sandhills and the loess owe their extensive deposition to this force. In the northern Great Plains glacial deposits modify the surface.

Where the running water has been the principal agent of erosion, the extent and character of the local surface-sculpturing in any part of the area has been determined by the amount of rainfall in that particular locality. In the eastern part, where the rainfall is adequate for the purpose, erosion has smoothed the hills and given the pleasing rounded contours characteristic of the humid regions, but in

[1] Adapted from the following publications of the United States Department of Agriculture: T. D. Rice, "Reconnoissance Survey of Western Nebraska," *Bureau of Soils, 1913*, pp. 7–17, 27–28, 34–35; J. A. Warren, "Agriculture in the Central Part of the Semiarid Portion of the Great Plains," *Bureau of Plant Industry, Bulletin No. 215*, pp. 9–24.

the western portion, where the rainfall is less abundant, the cutting of the water courses has been more abrupt, and deeply cut valleys, sharp hills, and deep gorges are characteristic features of the landscape.

Climate. The Great Plains have a semiarid continental type of climate. It is impossible to fix a positive and definite line on the one side of which we shall say the country is humid and on the other semiarid, for there is no sudden dropping-off in precipitation, but a fairly uniform decrease from east to west across the Plains. As generally used, the term refers to a country receiving an average of between 10 and 20 inches of melted snow and rain annually, but in determining aridity or humidity evaporation is of equal importance with precipitation. In southern Texas much more than 20 inches of precipitation may be required to make a humid country, but 20 inches of rainfall in the Red River region of North Dakota makes a distinctly humid climate.

Precipitation. Given a fertile soil, the yield of a crop depends upon the relative distribution of heat, moisture, and light throughout the season. Given favorable conditions with respect to all the foregoing except one, that one becomes the limiting factor of success—the all-important question. In most of the Great Plains region all these conditions but one, moisture, are favorable for crop production. Thus it is that the amount and distribution of rainfall become the question pre-eminent, and moisture conservation becomes the vital problem to all farmers.

There is a fairly uniform decrease in precipitation from east to west across the Plains. This decrease is 1 inch to about 17 miles along the south line of Kansas, 1 inch to about 21 miles along the north line, and 1 inch to about 40 miles along the north line of Nebraska from the Missouri River west. Over most of the region 70 per cent or more of the precipitation falls during the growing season.

The rainfall is very uneven in distribution, a large part of it falling in the form of local showers which cover but limited areas and are often torrential in character. This makes the rainfall extremely variable, both as to annual precipitation and distribution through the season. Instead of calling the region "semiarid" it would be more properly described as varying from year to year between arid and humid. This variability is the most serious feature of the climate. If dry seasons came with any regularity the settler

could be prepared for them, but coming as they do with no regularity and without warning, they are the constant dread and often the ruin of the homesteader. If the precipitation were fairly uniform and favorably distributed the conditions might be easily met, but this variability has always been the limiting factor of success. It is this, more than the scarcity of moisture, that must be overcome.

Evaporation. From an agricultural standpoint evaporation is of equal importance with precipitation, although few people appreciate this fact. It is this factor which determines the amount of water needed to produce a crop. The water actually contained in the crop at any time is so small as not to be worth considering. It is the water that passes through the plants into the air and the amount lost from the soil which determine the amount necessary for the welfare of the crop. The amount of water within reach of the roots of plants is of no greater importance than the rate at which it escapes through the leaves and stems. The water used by the plants is that which passes through them and the small amount retained in their bodies. The balance of the precipitation in this region is nearly all lost by evaporation directly from the surface of the soil, very little escaping through seepage.

The amount of water used by plants is far from uniform for all parts of the region, being greatest in the warmest and windiest parts and growing less as temperature and wind velocity decrease. For this reason an inch of water in the Panhandle of Texas is not comparable with an inch of water in North Dakota. The amount of water lost through plants in the semiarid region, or, in other words, the amount of water necessary to produce a crop if all loss from the soil could be prevented, is not well known. It is, however, known to be far in excess of that required in more humid sections.

Winds. The semiarid portion of the Great Plains is the windiest extensive area in the United States. High wind velocity has an important bearing on agriculture. It has a positive value as a source of power for pumping water and is occasionally utilized to run feed-grinders and other small machinery. It also enables the farmer to cure feed quickly and in excellent condition. The value of the pastures of the region for winter grazing are due in large part to the work of the wind in curing the grasses into hay on the ground. However, the beneficial results fade into insignificance when compared

with the damage done. On many days it is a great hindrance to labor, especially if hay or grain is to be handled; it blows the soil badly, sometimes removing several inches from bare fields in a short time. This drifting absolutely prohibits summer tillage on light soils; the blowing sand cuts off crops and the wind does much damage by whipping and splitting the leaves. All of these facts mentioned, however, are of small importance when compared with the effect of wind on the evaporation of water from the soil and from plants.

Light. The whole semiarid country is a region of intense sunlight. On account of the clearness of the air, the small amount of cloud, and the rarity of the air caused by the high altitude, the sun's rays lose much less energy before striking the earth. It is known that plants use more water when exposed to strong light. With fairly favorable conditions of heat and moisture the quality and yield of grain depend largely on the intensity and duration of light. It seems comparatively certain that this is one of the main factors responsible for the uniformly high quality of grain produced in the semiarid region and the large yields obtained whenever an adequate supply of moisture is available.

Irrigation Water. The extent of territory in this region that can ever be irrigated is, indeed, an extremely small proportion of the whole. At best, the water in the streams is sufficient for only small patches in comparison to the whole, or narrow strips along the streams. This water is supplied mainly by the precipitation in the mountains. The amount of water lost by surface run-off in the semiarid region itself is comparatively small and is commonly much exaggerated. It would in reality make only a thin covering over the entire surface. We see water flowing in a draw and think of its volume, but do not stop to think how far apart the water courses are, and from what a large area the little stream collected the water.

Original Settlement of the Region. For forty years, at least, the history of the settlement of the Plains has been one of periodic advance and retrogression. Periods in which settlement was rapid, energetic, and general have alternated with periods when abandonment, desertion, and return were almost as rapid and often prosecuted with as little judgment. But each wave of settlement pushed permanent agriculture farther west. The recoil never forced it back to its former limits, nor were the desertions ever complete. After

each exodus, scattered settlers remained all over the territory that had been occupied.

The first wave that really populated the semiarid region was at its height in 1886. This wave carried settlement across the western counties of Kansas and Nebraska and well into Colorado. There was, however, a wide strip of public land still vacant east of the foothills across Colorado and farther north, in Wyoming, and in some of the extreme western counties of Nebraska. Not only did the settlers fail to appreciate the difficulties before them, but many were wholly unprepared to face any hardships. They came, not only without any knowledge of the country, but without money with which to establish themselves—without means of maintenance till crops could be grown, to say nothing about stock and machinery. They had little or no working capital. They believed that if they could only get a "claim" they would succeed some way.

A few good crops came, then poor seasons, and the return commenced. Dry seasons and the panic of the nineties struck together with disastrous results. Lands which had been priced at from $5 to $20 or more per acre were offered for taxes, and often without a bidder. Under these conditions much of the land naturally fell into the hands of loan companies and farseeing speculators. In one county several thousand quarter sections were allowed to revert to the county for taxes. These were finally all sold to a single company at $30 per 160 acres. The abandonment was so complete in places that towns once of several hundred inhabitants were marked only by the empty school buildings, the cellars, and the hydrants remaining from the city water systems.

At the time these lands were first taken little or nothing was known by the average settler concerning the climate. If there was a suspicion that rainfall was deficient, it was entirely lost sight of in the delusion that rainfall followed the plow. The homesteaders confidently expected that in a few years the short-grass country would prove itself the equal of eastern Nebraska and Iowa, and that the same methods of farming would be equally successful. They finally awoke to their mistake, and, not knowing any way to meet the hard conditions, returned generally to the region from which they had come.

This desertion took place during the period of the lowest prices which a generation has known and during the most severe series of dry

seasons experienced in forty years, if not in the entire history of the country; years when farmers in the best agricultural sections of the country were obliged to sell horses, cattle, and hogs for anything they would bring, for lack of feed to keep them. Economic factors were as potent in bringing about these conditions as natural ones.

Beginning about the year 1898 and continuing until within the last two years (1911), there was a period of well-distributed rainfall over the greater part of the Plains section, and the advance of population was resumed. The present settlement promises to be more permanent than the first. The farmers are now more conservative in their expectations of the country than were the pioneers, and they are also bringing with them knowledge of scientific agriculture applicable to the Plains.

In considering the problem of agriculture in the Plains it must be understood that the same native flora which existed on the Plains when they were first settled occupies them today; the same climatic conditions which caused the ruin of the early settlers must be met by the settlers of today; the same soil conditions which the homesteader then found confront the "dry farmer" of the present; the same grass mixture which pastured the first homeseeker's stock and in some cases furnished hay for the winter is still there. As man has not changed the climate, neither has he changed the plant growth on the prairies.

Economic Conditions in the Great Plains Changed. What has just been stated is not that the farmer on the semiarid Plains today has the same combination of conditions to meet that he had twenty-five years ago when the region was first invaded. It has been pointed out that agricultural factors are of two classes, natural and artificial, and one of these sets of factors is as important as the other. While the forces of the first group are fixed, those of the second are constantly changing. It is just as essential to have a market as to have a crop. Whatever differences there may be between the conditions that surround the settler on the dry lands today and those that faced the settler of a generation ago on the same land, these differences are not in soil, climate, or native vegetation. They are economic and industrial differences—differences in the machinery available, the methods of cultivation practiced, the varieties of crops at hand (durum wheat, brome-grass, kafir, milo, sorghum, emmer, alfalfa

and hardy species of barley and oats), and the prices of products. The changes in these respects are great, so great that the total combination of all conditions make, as it were, almost another country. The improvement in machinery is so great that Professor Snyder, of the substation at North Platte, Nebraska, has said, "Take away the disk, the press drill, and the corn machinery, and western Nebraska would still be a place for the cattleman." A parallel statement with regard to the crops that have been introduced during the last fifteen years may be made, but great as is the effect of these changes, the advance in prices of products is of still greater importance.

CHAPTER XII

WESTERN UNITED STATES

1. THE RELATION OF WATER RESOURCES TO ECONOMIC ACTIVITIES IN THE WEST[1]

Irrigation. Few people need to be reminded that the prosperity of the West depends largely upon an adequate supply of water for irrigation. Water, rather than land, is the open sesame to the agricultural development of the semiarid regions. Vast areas of rich soil await only water to make them "blossom like the rose." To other vast areas water has already been brought from varying distances, and these are now among the most productive of all our agricultural lands. Irrigation alone is responsible for the sugar-beet fields of Utah, the alfalfa fields of Idaho, and the orange groves of California.

So literally has water meant wealth to the Rocky Mountain and Pacific Coast states that the "Golden West" no longer need base its claim to the title on the magic metal that brought it fame and prosperity in the early days. The gold of the grain field and of the citrus grove is now worth more than the gold of the mine. The $247,000,000 which represents the annual value of the crops produced on the 150,000 farms comprising the 13,200,000 acres of irrigated land in the West is nearly three times as great as the value of the precious metals produced annually in the same region. Colorado, pre-eminently a land of minerals, now produces each year on irrigated lands a crop worth more than the entire product of its mining industries and approximately twice as much as the output of precious metals. California, the "Golden State," contributes annually nearly four times as much wealth in crops as in precious metals.

If the precipitation were as evenly distributed in the West as it is in the East, there would not be the need for irrigation that now

[1] Adapted from Samuel T. Dana, *What the National Forests Mean to the Water User*, United States Department of Agriculture, Forest Service, 1919, pp. 3–20.

exists. But it is not evenly distributed, and that is where the trouble lies. Except for a narrow strip along the Pacific Coast from San Francisco north to the Canadian line, the great bulk of the precipitation occurs in the mountains. Throughout the Coast Ranges, the Cascades and Sierra Nevadas, and the Rocky Mountains and Colorado Plateau, the rain and snowfall is far greater than in the intermediate valleys and plateaus.

The result is that the majority of water-users depend for their supply on water that originates a considerable distance away. Some of the most productive agricultural lands in the region receive hardly more than enough precipitation to support a desert vegetation, while the evaporation is correspondingly great. Greeley, Colorado, Provo, Utah, Phoenix, Arizona, and Fresno and Riverside, California, all of which are in the center of extremely productive sections, have an annual precipitation of less than 15 inches with an annual evaporation from a free water surface at least three or four times as much.

As a natural consequence of the difference in amount of precipitation in the mountains and at the lower elevations, the former are generally forested and the latter treeless. The national forests, of course, are located in the mountains, where the trees are. From the brush-covered foothills of the San Jacinto and San Bernardino Mountains in southern California to the magnificent Douglas fir forests of the Olympic Mountains in northern Washington, and from the piñon and juniper stands of the southern Rockies in New Mexico to the pine forests of the northern Rockies in Montana and Idaho, the mountains and the national forests coincide.

An intimate relation, therefore, exists between the national forests and irrigated lands throughout the West. At least 85 per cent, and very likely more, of the water used to irrigate these 13,200,000 acres, whether it comes from surface streams and lakes or from underground sources, has its origin in the mountains where the national forests are located. Obviously, not all of this mountain area is forested, nor is all of the forested area under federal ownership. At the same time, the national forests include a large part of the area from which the bulk of the irrigation water is derived, and must therefore exert an important influence on the amount and character of the supply.

No figures are available as to the exact value added to these lands by the application of water, but it unquestionably runs into the hun-

dreds of millions of dollars. Without water much of this area would be practically worthless, and the value even of that portion on which dry farming is feasible would be greatly reduced. In the vicinity of Salt Lake City, Utah, for example, irrigated lands deriving their water from the Wasatch National Forest are valued at from $100 to $1,000 per acre, with an average of probably $400 per acre; while land without water in the same district, except where it requires drainage, is practically valueless. Near Los Angeles, California, unimproved lands with water rights are worth from $200 to $500 per acre, while bearing orange or lemon groves may be valued at $3,000 or even more per acre. What the water supply protected by the Angeles National Forest means to this region is also well illustrated by the value of the crops produced on irrigated lands that without water would be of little or no agricultural value. In 1915, 25,750 acres devoted to citrus fruits, alfalfa, and sugar beets, deriving their irrigation water from the San Antonio watershed, with an area of only 24 square miles, yielded crops valued at $5,400,000; while 5,870 acres of citrus fruits, deriving their water from the San Dimas watershed, with an area of only 18 square miles, yielded crops valued at $2,600,000.

Water Power. Irrigation represents one of the vital needs for water in the West, but there are others. Water is the "white coal" which furnishes or will furnish the motive power for lighting systems, trolley lines, and manufacturing plants everywhere in the western states. As such it constitutes an immensely valuable resource. The western mountains contain more than 72 per cent of the potential water-power of the United States. Through lack of markets, only a comparatively small part of this has been utilized, but in the last twenty years great strides have been made in development. In the decade from 1902 to 1912, for example, water-power development in the western states increased 451 per cent, or more than four times as rapidly as in the rest of the country. How rapidly water-power is developed in the future will depend solely on how many new industries and people make their home in the West. Judged by how many have gone there in the past, the demands of the western states upon their "white coal" will continue to multiply.

No less than 42 per cent of the water-power resources of the eleven western states, or approximately 31 per cent of the water-

power resources of the entire country, is actually within the national forests. Moreover, a large part of the remaining power, although developed outside of the forests, is derived from streams rising in them. In 1915 nearly 42 per cent of the water-power already installed was developed by plants some part of which occupied national-forest lands or which were directly dependent on storage reservoirs constructed on national-forest lands, and 13.6 per cent more was similarly dependent on other public lands. Even these figures, however, do not bring out the full significance of the national forests in their relation to the water-power resources of the West. A large part of these resources outside of the forests are so located as to be extremely difficult of development under present conditions, and so a continually increasing proportion of new water-power developments is utilizing sites within national forests or other public lands.

Navigation. Farther downstream, in the lower reaches of the rivers and in the harbors into which they flow, water contributes still further to western prosperity. Inland water transportation in the Mountain and Pacific states will never attain the development of which it is capable in the eastern and central states, but it is already of considerable importance, and should become increasingly so as the population grows denser and traffic correspondingly heavier. According to the 1916 report of the Chief of Engineers, United States Army, there were at that time some 26 navigable streams in the western states, with a navigable length of approximately 1,746 miles and an annual movement of over 14,000,000 tons valued at more than $250,000,000.

The relation of the national forests to navigation is not strikingly obvious, since practically all the navigable portions of western streams lie outside of the forest boundaries. Yet by far the greater part of the water that they carry originates in their upper courses, which are to a large extent included within the national forests. Any influence that the forests may exert on this water is therefore felt indirectly, but none the less surely, by the streams and by the harbors into which they flow.

Drinking Water. Ordinary drinking water may lack the romantic associations of some other beverages, but it nevertheless is an everyday necessity for thousands of families scattered on farms and ranches and in numerous small settlements throughout the West and for the

still larger population comprised in the towns and cities. How much effort and money must be expended by western cities in obtaining a pure and abundant water supply is shown by the examples of Los Angeles and San Francisco, the first of which has considered it worth while to spend some $25,000,000 to bring water from Owens Valley on the east side of the Sierras across 250 miles of desolate and rugged country; while San Francisco is going back 190 miles into the fastnesses of the Sierras at an estimated cost of $77,000,000 in order to get its supply from the famous valley of the Hetch Hetchy.

Some 732 western towns and cities, with an aggregate population of 2,265,000, depend on the national forests for their domestic water supply. This does not include, of course, ranches and small settlements equally dependent on the forests, nor the towns and cities securing their domestic water from streams and underground supplies which are at some distance from the forests, but which rise from sources within them. Denver, Colorado, Salt Lake City, Utah, Los Angeles, California, and Portland, Oregon, are conspicuous examples of large cities which are insured a pure and abundant water supply by the national forests. So important is this function of the forests that many communities have entered into co-operative agreements with the Forest Service for the better protection of the watersheds from which they get their supplies.

Erosion. Perhaps the most obvious relation that exists between forests and water is the tendency of the tree cover to check erosion. The leaves and branches of the trees prevent the rain from beating upon the soil as it does in the open; the cover which they afford delays the melting of snow in the spring; the upper layers of the forest soil act as an enormous sponge that absorbs large quantities of water which in turn are passed on to the great reservoir of mineral soil beneath; and finally, the surface cover of stumps, fallen twigs, branches, and even whole trees acts as a mechanical obstruction to prevent rapid run-off. The surface run-off from forest areas is less, both in total amount and in velocity, than that from similarly situated unforested areas. The steeper and more rugged the topography, the more marked is this contrast.

In hilly country some erosion is, of course, inevitable under any conditions. When the soil cover of trees, underbrush, and litter is kept intact, however, this is more often beneficial than otherwise,

since only the lighter soil particles are washed away, to be later deposited in the more level lands below, adding to their fertility. But when this protective cover is interfered with, whether by fire, destructive lumbering, overgrazing, or injudicious clearing of land for agriculture, the proportion of coarser, infertile materials washed away increases greatly and transforms erosion from a constructive into a dangerously destructive force, difficult of control and capable of doing untold damage.

From the standpoint of the water-user, the tendency of the mountain forests to prevent erosion is of the utmost importance. Wherever storage reservoirs must be used, whether for municipal supplies, irrigation, or water-power, they are exposed to the ever present danger of silting up. Every bit of soil brought down by the streams and deposited in them reduces their capacity and consequently their effectiveness by just so much. This sedimentation is serious under any condition, but doubly so when, as not infrequently happens, no other satisfactory dam sites are available and the reservoir cannot be replaced at a reasonable cost.

Water heavily laden with eroded material often decreases the efficiency and increases the cost of maintaining diversion dams, pipe lines, flumes, canals, and other irrigation works. Sometimes such water damages the crops to which it is applied, and not infrequently it seriously injures or even ruins the land by burying it under a mass of sand, gravel, bowlders, and other infertile débris. Excessive erosion may interfere seriously with navigation by filling the streams with material which is deposited in their lower reaches and in the harbors into which they empty.

The action of the forest in reducing surface run-off tends also to regulate the flow of streams. Instead of rushing away in uncontrollable torrents, the water is absorbed into the great reservoir of mineral soil, from which it is gradually paid out to the springs and streams. This tends to decrease the high water run-off and to increase the low water run-off. Both results are good. The decrease in the high water run-off means that there is less danger of destructive floods and less waste of valuable water; while the increase in low water run-off means that a larger supply of water is available during the dry season, when it is particularly needed. It is the low water flow

that to a great extent determines the availability of any given supply for municipal use, irrigation or hydroelectric development.

What One National Forest Does. A typical example of the ways in which the national forests benefit the water-user is furnished by the Pike National Forest in Colorado. This forest extends along the main range of the Rocky Mountains from somewhat north of Denver to south of Colorado Springs, and includes within its boundaries a considerable portion of the headwaters of the South Platte and Arkansas rivers.

Irrigation by means of water coming from the mountains included in the Pike National Forest had its modest beginnings in 1860 along the South Platte River in South Park and also near Denver. Since then the area on which irrigation is practiced has grown steadily, until now it is estimated at some 400,000 acres, valued at about $40,000,000 and with an annual crop production of over $10,000,000. On many acres where water is not available dry farming is practiced, but the results are uncertain and the yields much less than on irrigated land. The value of water in this region is so great that the natural flow of the streams is greatly overappropriated, and there is need for every additional drop that can be developed or stored. Practically all of the Great Plains lying east of the Rocky Mountains is potentially agricultural land, and the only limit to its development is the amount of water which can be secured for irrigation. So well recognized is the part played by the forest cover in protecting the water supply that in one case an organization of farmers has protested against any cutting of timber on certain watersheds.

No less important is the use of the water for domestic and municipal purposes. Denver has its main storage reservoir, Lake Cheesman, with a capacity of about 26,000,000,000 gallons and a watershed of 1,152,000 acres, in the heart of the Pike Forest. Colorado Springs has a series of reservoirs which also get their supply from the Pike. Altogether, some thirty-five cities and towns with an aggregate population of 275,000, and an investment in water works of over $17,600,000, obtain their domestic supply from this forest. The watersheds supplying Denver, Colorado Springs, Manitou, Cascade, and Idaho Springs are given special protection against fire. At the request of local residents, Congress has added nearly 28,000 acres to

the Pike Forest, while farther north, on the Colorado National Forest, Congress in 1916 authorized the addition of some 540,000 acres for the purpose of watershed protection.

Where fire has destroyed the forest cover on certain of the watersheds within the Pike, young trees are being planted. Already some 3,000 acres have been planted by the Forest Service on the watersheds denuded by the great fire of 1866, from which Colorado Springs and its suburbs obtain their water, and plans have been perfected for the reforestation of an additional 9,000 acres.

The development of hydroelectric power bids fair to constitute another important use of the streams which take their rise in the Pike National Forest. It is only in recent years that water in this region has been utilized for power, but the possibilities for development offered by the streams are tremendous.

Placer mining, which, aside from drinking and bathing, probably called for the first use of water on the Pike National Forest, is now practically a thing of the past. The use of water in the milling of ores, however, is quite common in a number of districts, and there are many mills which could not operate without an abundant and constant supply.

The value of water as a scenic, or esthetic, asset, and its contribution to recreation in the region, should also not be overlooked. To the Pike's Peak region come thousands of visitors every year, attracted by the scenery and climate. Periodically dry streams and eroded stream beds are far from attractive, and in helping to prevent erosion and to maintain a steady stream flow the forest adds materially to the value of the region for the tourist and pleasure-seeker.

2. THE DESERT REGION OF THE UNITED STATES[1]

The desert region of the United States forms a great triangle whose base, 800 miles long, is the Mexican border from the Peninsular Mountains, in southern California, to the mouth of the Pecos River, in Texas, and whose apex is in north-central Oregon. The west side of this huge desert triangle is the mountain wall formed by the Peninsular Mountains, the Sierra Nevada, and the Cascade Range;

[1] Adapted from O. E. Meinzer, Preface to John S. Brown, "Routes to Desert Watering Places in the Salton Sea Region, California," *United States Geological Survey, Water Supply Paper 490-A*, p. 1.

the east or northeast side is a less definite line extending from north-central Oregon through Salt Lake City and Santa Fé to the mouth of the Pecos River. It covers about 500,000 square miles, or very nearly one-sixth of the area of the United States.

This region is by no means devoid of natural resources or human activity. It contains prosperous cities, fertile agricultural districts, forest-clad mountains, a large aggregate number of watering places, many rich mines, and an unknown wealth of mineral deposits. But the localities that have water supplies are widely separated oases in a vast expanse of silent, changeless, unproductive desert, whose most impressive feature is its great distances and whose chief evidences of human occupation are the long roads that lead from one watering place to another.

In the future existing oases will be enlarged, many new ones will be created, and the mineral and agricultural product of the region will be greatly increased. But in spite of all that man can do this large region will remain essentially a desert.

Travelers in this region must depend for their existence on the desert water holes (springs, wells, or natural tanks), many of which are separated from one another by a hard day's journey with team and wagon. For most of the region the water holes have never been accurately mapped or described, no systematic provision has been made for maintaining them, and the roads leading to them have not been marked with substantial and reliable signs. Hence travel in the remote parts of the region has been a precarious and sometimes a dangerous undertaking.

3. SEMIARID HIGHLANDS OF THE SOUTHWEST[1]

Arizona is divided into two main physiographic provinces, the Colorado Plateaus and the Arizona Highlands; but some physiographers recognize a third, including the southwestern part of the

[1] Adapted from the following *Bulletins of the University of Arizona, Agricultural Experiment Station:* A. M. McOmie, "Dry-Farming in Arizona," *No. 84*, pp. 499–530; G. F. Freeman, "Alfalfa in the Southwest," *No. 73*, pp. 233–35; Alfred J. McClatchie and J. Eliot Coit, "Relation of Weather to Crops and Varieties Adapted to Arizona Conditions," *No. 78*, p. 52; F. W. Wilson, "Improved Types of Sheep for the Southwest," *No. 69*, pp. 621–26.

state that lies within the Colorado Desert. Because of the very limited rainfall in this last division it cannot be considered a region with dry-farming possibilities; consequently only the first two provinces are discussed in this bulletin.

The Colorado Plateaus. The Colorado Plateaus province includes northeastern Arizona, southeastern Utah, southwestern Colorado, and northwestern New Mexico. In Arizona its southwestern border runs fairly straight from the northwest corner of the state to a point slightly south of the middle of the eastern boundary. The Colorado Plateaus province consists, mainly, of a series of table lands 5,000 or more feet above the sea-level with occasional intrusions and extrusions of igneous rocks, particularly in the southeast portion.

Soils. Many strata outcrop in belts on the surface of the plateaus, sandstones and shaly sandstones covering the largest area. Soils resulting from the weathering of these strata as a rule are rich in iron, poor in clay, and infertile. In some places sandstone strata are covered with a thin veneer of limestone, and the resulting soil is somewhat more productive. Strata of lava cover the next largest area. Soil formed by decomposition of this material is usually high in fertility, but in the Colorado Plateaus province most of the lava has appeared too recently to allow of much more than mechanical disintegration. Limestone strata outcrop on quite extensive areas, the principal one being the Kaibab Plateau, most of which lies north of the Grand Canyon. Well-weathered limestone soils are very fertile. A considerable area of alluvial soils is found. The abrupt slope of the Colorado Plateaus province, averaging about 200 feet per mile, assists rapid erosion by the young rivers of the region. The finer and more disintegrated portions of exposed strata are transported great distances, separated by gravity, and deposited in the broader valley bottoms. Soils thus formed, composed of the finest materials of various strata, are very fertile.

Water Supply. The general arrangement of strata in the plateaus is unfavorable for economic development of ground water. In places, wells have been drilled to a depth of more than 1,500 feet without success. However, water is occasionally found near the surface of the Plateaus, but only in localized spots, and in many cases it is so charged with minerals that it is unfit for domestic use. Water may usually be developed at a slight depth along the main courses of the valleys,

but it is often strongly alkaline. In some places, notably near St. Joseph, artesian water has been found at depths of 200 to 800 feet.

About an inch of precipitation is the normal increase for every 500 feet of added altitude on the border of the Plateaus, and for every 250 feet within the border of the Plateaus. However, the abruptness of the southwestern and western boundaries of the region causes precipitation of moisture from passing winds to such an extent that the lower elevations in plateaus beyond are arid or semiarid. In general, only the highest plateaus have an annual precipitation of more than 22 to 24 inches. There are distinct summer and winter precipitation maxima and great differences between temperatures at the various elevations.

Arizona Highlands. The Arizona Highlands province, a continuation of the Great Basin, is a mountainous belt from 70 to 150 miles wide, crossing the state from northwest to southeast. It is characterized by short and nearly parallel mountain ranges of monoclinal structure and rarely above 8,000 feet elevation. For the most part these mountains are abrupt and denuded of soil except in timbered places. Alluvial soils of many of the valleys and basins that occur throughout the area are valuable for agricultural purposes.

Throughout the Arizona Highlands province, precipitation mostly falls in local torrential showers, and the resultant water erosion is excessive and important. The surface of the region exposes many strata, intrusions, and extrusions, and there are few large, uniform areas of interest to dry-farmers, except in the southeastern part where extensive fertile limestone soils are found. The localized precipitation varies greatly from year to year, and over no large area is the average more than 16 to 17 inches. Temperatures are generally higher and precipitation lower than in the Colorado Plateaus province. The entire Arizona Highlands province must be classed as arid and semi-arid.

Climate. It is essential that the climatic conditions of Arizona be understood by farmers, since they are not duplicated in any other part of the United States, excepting in adjacent regions of bordering states, and are subject to extreme variations in relatively short distances.

Arizona, in common with all of the region between the Rocky Mountains and the Coast Ranges, is subject to great variations

between minimum and maximum temperatures. The effects of extreme temperatures, however, are not so pronounced as in a humid climate. The wide variation in temperatures of night and day has a decided effect upon plants. Certain sorghums, for example, which will mature in a given number of days in a region having approximately the same maximum temperature as Snowflake (east-central Arizona) fail to ripen at the latter place in a considerably longer time, though they may not be at all injured by frost. Night temperatures of the frost-free season in the higher altitudes of Arizona, while not low enough to directly injure tender plants, are too low to permit proper development throughout a large part of the growing period.

Furthermore, there is a greater variation between average and extreme dates of the last killing frost in spring and the first in autumn than is ordinarily expected. For this reason it is more or less risky to plant crops which demand all of the expected frost-free season for their maturity.

In general there are two precipitation maxima, one in midwinter and one in midsummer. Winter precipitation, which is of greater importance in northeastern Arizona, occurs either as snow or a gentle downfall of rain and penetrates quite completely into the ground. Individual showers usually cover a considerable territory. Summer rains, of primary importance in southern Arizona, occur as local torrential showers, often lasting but a few minutes and rarely continuing more than a couple of hours. It is difficult to have these rains penetrate well, since ½ inch of precipitation, occurring in a few minutes, is apt to start a considerable surface run-off, and occasionally more than 75 per cent of the heavier showers is lost in this way. Individual showers of ¼ or ⅓ inch, occurring at intervals of two or three days, have no real value, and often necessitate considerable work to preserve a mulch. An inch of precipitation falling thus intermittently may be detrimental; whereas, if the showers had come very close together, or if an inch of precipitation had fallen in one or two showers, the effect would have been beneficial.

The amount of moisture lost by surface run-off is great, often being sufficient to close all traffic for several hours at a time even on main roads. Since so much value is lost in this manner, one of the problems of successful farming is proper utilization of floods. In

this, Arizona Indians are masters. There are thousands of acres within the state which may be irrigated occasionally by these floods.

Dry-Farming. The Indians of Arizona, numbering from 40,000 to 45,000, have contributed very materially to agriculture in the state. Dry-land crop varieties, which have been grown by them for an indefinite period, are among the most promising; and their cultural practices, with some modifications, are the bases of successful dry-farming in Arizona. The total area within the state at present set aside as Indian reservations is about 17,500,000 acres. According to careful estimates it is possible to irrigate nearly one-quarter million acres of these lands, 109,992 acres now being under projects. The agricultural value of lands in the reservations varies from worthless to the best in the state.

Since the rainy season of 1905, when accidental plantings of barley by teamsters feeding their animals by the roadside attracted the attention of land-hungry settlers, a persistent and increasingly ingenious effort has been made to discover methods of utilizing our semiarid lands for farming purposes. In the southern part of the state at the altitudes of the great valleys it is fairly well determined that the ordinary rainfall should be supplemented by stored or pumped irrigating waters, used at critical times to start or save a crop. Subsequent work in the northern part of the state at somewhat higher average altitudes indicates that it is possible, with good management and skilful handling, to produce a fairly reliable output of dry-farmed forages without the help of irrigating water.

In the southern part of the state the crops apparently best adapted to altitudes of 4,000 feet with a long growing season include kafir, club-top sorghum, milo, and tepary beans. In the northern part of the state, under less stringent conditions, the crops that may be grown include not only kafir, club-top sorghum, milo, and tepary beans, but also various Indian corns such as Papago sweet corn, White Hopi corn, and other quick growing, drought-resistant varieties. Sudan grass for hay, potatoes, and several varieties of beans, and even orchard fruits, have been found feasible under these conditions.

But of equal importance with the production of these forages has been their preservation as silage, in which form but a small percentage of nutritive value is lost as compared with the very great loss in nutritive value incidental to the common practice of cutting

and shocking such forages. This silage is used to great advantage in connection with live stock of all kinds, particularly range cattle which are subject from year to year to a period of shortage during which an average of 2 per cent or more die, the remainder coming through in very poor condition for the next season's operations. The silo, in fact, properly developed, is the range stockman's salvation if he will utilize it to the best advantage.

Importance of Alfalfa in the Southwest. Every agricultural community has its staple product. What corn is to Illinois, wheat to Kansas, and cotton to the Gulf states, alfalfa is to Arizona. More than one-third of all her cultivated land is devoted to its culture; and the revenues from it add more than two million of dollars annually to the wealth of her farmers. More valuable than any other single crop, it forms the basis of the agricultural wealth of the state—the safeguard of cattlemen in times of drought, the raw material for a growing dairy industry, the natural food for fine, fat stock, and the conserver of soil fertility by its deeply penetrating, nitrogen-gathering roots.

Within thirty years alfalfa rose from comparative insignificance to the most important place in our agriculture. The reason for this quick rise of alfalfa to dominance lies in its almost perfect adaptation to our soil and climate, and to the abundance of rich forage which it produces. The experience of two thousand years has shown that it thrives best in the soils and climate of arid and semiarid regions. No crop is so perfectly at home under irrigation and none so well adapted to withstand the extremes of heat and atmospheric aridity to which it is often subjected in this dry subtropical country.

Alfalfa succeeds admirably in all parts of the Southwest where suitable soil and sufficient water are available. It is little affected by altitudes encountered within the farming sections of the state. It succeeds in the Imperial Valley of California, below the sea-level and on the farming lands around Prescott and Flagstaff at elevations of over 6,000 feet. When supplied with plenty of water it will make some growth in every month of the year in the lower valleys, but at the high elevations of northern and southeastern Arizona it is completely dormant in winter. Seven cuttings are the rule in the vicinity of Yuma, six cuttings in the Salt River Valley, five in the upper Gila Valley, and from three to four at high altitudes in the

northern part of the state. Growth is most rapid in spring and early summer, and the second cutting is usually the heaviest. In midsummer, due to the intense heat and the attacks of leaf hoppers and the larvae of the alfalfa butterfly, the crop is usually light, but with the coming of the cooler weather of September the growth is more vigorous. Varieties differ in this respect. The ordinary American and Turkestan types show most the effect of summer retardation of growth, whereas the Peruvian and Mediterranean alfalfas show least.

The Sheep Industry. Sheep-breeding is one of the more important agricultural industries of Arizona, and, with improved management of the open ranges and the prospective increase of our irrigated valley pastures, promises further profitable development. Of the 52,362,000 sheep (1912) in the United States, valued at $181,170,000, about 1,510,000, valued at $6,493,000, are found in Arizona. Thus, an industry of such magnitude, in a country peculiarly adapted to a specialized breed, offers a promising field for improvement. This can be effected with regard to both wool and mutton. While Arizona ranks thirteenth among the states in the size of her flocks, she drops to fourteenth place in wool production. From the standpoint of mutton production, the raising of "Early Desert" or "Phoenix" lambs also seems to afford an opportunity for extensive and profitable development.

The present era of sheep-raising in the state dates from the introduction, late in the seventies and early in the eighties, of bands of Spanish and French Merino origin from California. Prior to this time, cattle-herding had been almost the only range industry, excepting among the Navajo Indians and the Mexican colonists who had held flocks for many generations. In the wool of these first Californian flocks came the seeds of alfilaria, which has been further disseminated by the same agency until today it forms one of the most important forages on the winter and spring ranges, materially promoting the welfare of the agency that brought it.

The Arizona flocks, because of the predominating Merino blood, furnish a fine, short-staple wool, classed on the markets as "territory wool." The average clip for Arizona is six pounds, but this includes the light-fleeced Navajos which lower the average. The shrinkage of Arizona wool in scouring is stated to be 65 per cent, but valley

sheep should make a better showing since their wool is dense and they are less exposed to blowing sands. The light-shearing Navajos, of which numerous flocks are found on the Navajo Indian Reservation in Arizona and New Mexico, furnish a long, rather coarse-staple wool of great value to the native weavers.

The Sheep Ranges of Arizona. Following the seasons, the flocks of northern Arizona migrate from their summer mountain pasture in the north to the winter desert ranges farther south, of which the largest lie north and east of Phoenix. The cool northern mountain range is utilized from May until August, when the flocks begin to drift slowly across the higher mesas toward the lower desert ranges. With the advent of warm weather in the spring they again drift back across the higher mesas to their summer mountain pastures. Thus twice each year the higher mesas furnish transitional pasture, well suited to the needs of these migratory flocks. Not only does this shifting of the range keep the flocks in similar climates at most seasons of the year, but the pastures at the various elevations are used when at their best. The flocks, moreover, are usually on or near the summer ranges when ready for market. Thus the important sheep centers in Arizona are found at Flagstaff, Ash Fork, Seligman, Cañon Diablo, Williams, and Winslow, on the main line of the Sante Fé Railroad and Prescott on the branch line extending to Phoenix.

The summer mountain pastures afford numerous bunch grasses, such as pine grass or Arizona fescue, wheat grass, and mutton grass, besides grama grasses and several mountain brome grasses locally called "wild oats." In addition to grasses, these pastures abound in various forage plants including wild vetches, beans, clovers, geraniums, yarrow, and other herbs, usually regarded as weeds, which make suitable forage for sheep. Among stockmen, sheep are reputed to clear the forests of weeds in preference to grass, which is left in large part for the cattle.

The higher mesas at the time of the spring migration abound in alfilaria and winter bunch grass, and, to a less extent, in winter annuals such as poppies, lupines, and purple paintbrush. During the summer and fall from July to October, crowfoot or mesa grama grass grows abundantly. At all times upon the mesas there is a plentiful supply of several small shrubs, collectively called "ramita" which are browsed eagerly by sheep.

The pastures of the irrigated valleys correspond more nearly to those of eastern farms. Here the principal forage is alfalfa, supplemented by intercultures of barley, wheat, and oats, and, at times, by sorghum, milo maize, and corn. Weeds may always be utilized as forage. During the winter, valley flocks are pastured in part on the surrounding desert range.

The lower mesas, or winter desert ranges, supply an abundance of characteristic winter annuals, chief of which are several species of the well-known Indian wheat and various representatives of the borage and mustard families. Here, also, alfilaria makes an important forage, although less abundant than on the higher mesas.

Sometimes, however, cold seasons check the growth of winter annuals, and flockmasters reach the lower ranges to meet disappointment and loss. It is possible, however, that this uncertainty of winter pasture may be offset, in part at least, by the use of silos. Corn and sorghum may be grown with the summer rain in certain favored localities and siloed for subsequent use. These conditions have an important bearing on the production of early lambs for the eastern markets.

The extreme conditions of intensely hot days followed by chilly nights which prevail for several months each year in semiarid regions, where forage also is scant and parched, and water scarce and saline, require a type of sheep with somewhat different constitutions than those of moist countries with abundance of cool, succulent pasture and sweet waters. The successful type in the Southwest must be active enough to gather forage over considerable areas under an intense sun, for there is usually little shade, and, at the same time to carry a fairly dense fleece. Heat resistance requires greater development in the sheep of the irrigated valley than in range sheep that pass the summer at higher levels. Another important feature is immunity to the sheep botfly. These insects are the cause of great mortality among sheep on the lower pastures and seem especially destructive among the sluggish, heavy mutton breeds.

4. THE BUTTE MINING DISTRICT[1]

Like other midcontinental states, Montana embraces within its borders the western part of the Great Plains region and the eastern part of the Rocky Mountain or Cordilleran region. The Mountain region, comprising the western third of the state, is an assemblage of ranges whose eastern front extends northwestward from the borders of the Yellowstone Park to the Canadian line. Its southern part is traversed by well-defined ranges, with intervening valleys whose fertile river bottoms and bench lands are well settled and extensively cultivated.

The Butte district lies in a well-defined mountainous tract in the center of this system of ranges. This tract, which lies mostly in Jefferson County, has long been famous for its mineral wealth. Helena, the capital of the state, stands on its northern flanks, and Butte, the greatest mineral-producer of the country, on its southern foothills. The broad Deer Lodge Valley, to the west, separates it from the towering peaks of the Mount Powell Range. On the east it is bounded by a continuous depression, formed by several separate valleys, which cuts it off from the higher ranges beyond. The tract thus outlined is broad and relatively low, none of its summits exceeding 9,000 feet in height, but it forms the main continental watershed separating the streams tributary to the Missouri River from those flowing into the Pacific Ocean.

Though often called the Bowlder Mountains, the tract contains no sharply outlined peaks, nor do its hills constitute a well-defined range. Its central part is covered by a forest of small pines, its lower slopes are open and grassy, and its valleys are arid; in scenery and mountain sculpture it presents a contrast to the more alpine type of the adjoining ranges. Its geology is equally distinctive, and in this, as in its geographic relations, it constitutes a unit.

The city of Butte is the largest settlement in the state. It is built about and over the copper mines which support it as well as the neighboring city, Anaconda, 20 miles distant, where the chief industry is the reduction of the Butte ores. Four transcontinental railways

[1] Adapted from Walter H. Weed, "Geology and Ore Deposits of the Butte District, Montana," *United States Geological Survey, Professional Paper 74*, pp. 16–22. Mr. Weed is a member of the United States Geological Survey.

run to Butte, and its traffic surpasses that of all the other cities of the state combined.

To one approaching the city the general appearance is most desolate. Bare, brown slopes, burnt and forbidding, from which all vegetation was long ago driven by the fumes from the smelters, rise from an almost equally barren valley. The city lies toward the base of the slopes. Within it and dotting all the hills about rise red mine buildings, which, with the great heaps of gray waste rock from the mines, form the most conspicuous feature of the landscape. The waters of Silverbow Creek flow through the valley toward the west, encircling the base of the slopes. West of the city is the sharply conical hill, Big Butte, from which the city takes its name. In itself, the city is not unpleasing, showing compact, well-built, brick business blocks and many residences on hills which command magnificent mountain views. The growth of the city northward is limited by the land owned by the mining companies, and the abrupt transition from compactly built blocks to the bare surfaces of many of the mining claims is very striking.

In the copper area the slopes are gridironed by railway tracks leading to the different mines, and great mine buildings, tall smoke-stacks, and steel hoist frames mark the course of the greater veins. Throughout the most of the silver area the monotonous aspect of the slopes is relieved only by occasional shaft houses, now mostly deserted, and by the almost innumerable prospect pits and trenches, which simulate gopher holes. Heaps of waste are everywhere prominent, attesting by their great size the extent of the underground workings. The many prospect pits and shafts permit a tracing of the veins, which otherwise would be in many places impossible.

The district is, as a whole, distinguished by a lack of prominent rock outcrops or strong topographic features. The Butte alone is conspicuous. In the north part of the district a number of striking rock outcrops do occur, but throughout the mineralized area disintegration and decomposition have been active agents and good outcrops are rare.

The climate is rigorous, owing to the altitude and midmountain situation, but precipitation is not abundant, the few streams are small, and the water supply not plentiful. Silverbow Creek, the largest stream, rises in the high granite region to the north, and

Missoula Gulch has a small natural supply. A few springs on the otherwise bare and arid slopes afford scanty flows. The city has, however, an abundant water supply, derived from the high peaks to the south, and ditches bring water from higher levels on the eastern side of the Continental Divide for the use of the concentrating plants and smelters. Vegetation is practically absent, but the stumps seen on Anaconda Hill attest a former forest growth and Dublin Gulch is said to have been once green with verdure and trees. Though the higher country near by is green and wooded, the Butte district was never abundantly watered nor deeply wooded, resembling in this respect the foothill tracts surrounding the valley outside the limits of the district.

Gold Mining. The discovery of the rich placer gold deposits in 1863 caused an extraordinary influx of population to the hitherto almost unknown mountainous region of Montana. A multitude of prospectors, trained in the gold placers of California, poured into the state and searched every valley and gulch for gold-bearing gravels. Gold was first noticed in the placer gravels of the Butte district in 1864. The following winter the Summit Valley district was organized and claims were staked out. Placer mining was not so remunerative here as at other camps of the state, for the gold was of low grade. Several ditch lines were built, and in 1866–67 three of these carried water to the "diggings." The amount of gold washed at Butte during the three years of placer mining has been estimated at $1,500,000.

The quartz veins prominent on the hillsides about the placer field were promptly located by the early miners. Claims along the Rainbow lode at Walkerville, a suburb of Butte, were located in the middle sixties; and at the Mountain Chief mine, ore was taken out, shipped by wagon train to Fort Benton and by steamer down the Missouri, eventually reaching Newark, New Jersey. The town of Butte was laid out in the fall of 1866 and reached its greatest prosperity of this, its early stage, in 1867–68; later it was nearly deserted until 1875, when copper-smelting began. After this it grew rapidly and became a city in 1879.

Silver Mining. No excitement arose over silver ores until the rich oreshoot of the Travona mine was found in 1865. No important development of the property occurred until 1876, when the first

successful treatment of the silver ores of the district was commenced. The climax of what may be called the silver period of Butte's history was reached in 1887. The period of active silver mining continued until 1892, when, in common with other silver-producers, the Butte mines were almost prostrated by the decline in the price of silver. The present importance of Butte as a producer of silver and gold is due to the fact that each pound of copper produced contains 0.0375 ounce of silver and \$0.0025 in gold, or approximately \$0.021½ in precious metals.

Copper Mining. The advent of the railroads marked the beginning of Butte's prosperity. The Utah Northern, which was finished to Butte in 1881, gave access through Ogden to the markets of the world over the Union Pacific lines. In 1888, the Montana Central Railway, which for some months had been racing with the Northern Pacific to get to Butte, was completed and thrown open for traffic. A few years later the Northern Pacific built a line from Three Forks direct to Butte. The Montana Union Road from Butte to Garrison, on the Northern Pacific, built by the Union Pacific interests, was finished in 1893. It is now owned and operated by the Northern Pacific system. The main line of the Chicago, Milwaukee & Puget Sound Railroad runs through Butte.

In the year 1883 the Anaconda Company commenced the erection near Anaconda, about 27 miles west of Butte, of what soon became one of the largest copper-smelting plants of the world. The organization of the Amalgamated Copper Company, in 1899, was one of the most important events in the history of Butte. As a holding corporation this company soon acquired control of the larger copper properties of the district, and now controls all the large mines.

The enormous value of its metallic product makes the Butte district the most important mining center in the United States and the second greatest in the world. Its annual production is exceeded in value only by that of the Rand, in South Africa, which was \$101,000,000 in 1905 against about \$65,000,000 for Butte. Up to the close of 1906 the total product of the Butte district may be roughly estimated at \$650,000,000, which is considerably in excess of that of Leadville and probably about that of the Comstock lode.

It is not possible to obtain strictly accurate data concerning the early production of the district, for in the pioneer days no records

were made and in later years some of the larger companies, for business reasons, have not been willing to disclose their exact output. The statistics presented in various publications, however, show that up to January 1, 1906, 971,000 ounces of gold, 194,000,000 ounces of silver, and 3,961,000,000 pounds of copper were mined in the district. Silver in the district is now mainly a by-product of copper mining, the copper ores containing about $\frac{1}{4}$ ounce of silver to 20 pounds of copper, or, in value, about 14 per cent of silver to 86 per cent of copper (1906).[1]

5. WATER RESOURCES OF CALIFORNIA[2]

The water problem in California, as in most states lying west of the Mississippi River, is one of great economic importance. The East has no water problem comparable in magnitude with that of the West. To give an idea of the significance of the problem as it exists today in California is the purpose of this paper.

California, the second largest state in the Union, includes approximately 160,000 square miles of the extreme southwest of the United States. Its latitude is equivalent in range to that part of the Atlantic Coast extending from Boston to Savannah. Partly because of its position and partly because of its diversified topography it is a region of great climatic contrasts.

The Rainfall. Precipitation, the only element of climate here considered, ranges from 1 or 2 inches per year, on the average, in the Mohave Desert, to more than 100 inches per year in the Sierra Nevada Mountains. Within the state are also included the region of greatest known snowfall in the United States and regions in which snow of measurable amount has never been known to fall.

There is a general increase in average precipitation from the southeast to the northwest, the mountains are regions of heavy

[1] The Butte district ranks first among the copper-producing districts of the United States, its output in 1916 being 17.42 per cent of the total for the entire country. It produced 30.16 per cent of the total output of blister copper in the United States from 1868 to 1916 inclusive. In 1916, Montana ranked second to Arizona in copper production (*Mineral Resources of the United States*, 1916, Part I, pp. 636–88).

[2] Adapted from Andrew H. Palmer, "Water Power in California," *Journal of Geography*, February, 1919, pp. 41–53. Mr. Palmer is meteorologist in the United States Weather Bureau.

precipitation, while the interior basins and the southeastern plateau regions have deficient precipitation. Records show that there is an increase in average annual precipitation up to a height of 5,000 feet, in the Sierra Nevada, and a decrease above that height. The average annual rate of increase up to 5,000 feet is about 8.5 inches for every 1,000 feet. The ultimate source of practically all the rainfall in California is the Pacific Ocean. As the moisture from it is brought in by westerly winds, the eastern and northeastern slopes of the mountains receive much less precipitation than the western and southwestern slopes. The rainfall is unequally distributed throughout the year, winter being the wet season, and summer the dry season. Toward the north the distribution of rainfall through the year becomes more nearly equalized. In southern California about 90 per cent of the annual precipitation occurs during the winter half-year, while in northern California the proportion is about 75 per cent.

The heaviest recorded precipitation for a calendar year in California is 156.90 inches, which occurred in 1911 at La Porte, Plumas County (Sierra Nevada), altitude 5,000 feet. Nearly every year at one or more stations precipitation is recorded exceeding 100 inches. As the greater part of the annual precipitation occurs during six months, extraordinary amounts sometimes fall within short intervals. The greatest amount recorded in one month is 71.54 inches, which fell during January, 1909, at Helen Mine, Lake County (Coast Range), altitude 2,750 feet. The greatest amount recorded in 24 hours is 16.71 inches, which fell January 16–17, 1916, at Squirrel Inn, San Bernardino County, altitude 5,280 feet. At Campo, San Diego County, altitude 2,543 feet, 11.50 inches of rain fell in 1 hour and 20 minutes, on August 12, 1891. The significance of these figures is apparent when it is realized that 1 inch of rain is equivalent to more than 100 tons of water to the acre.

By way of contrast, consider the record of Bagdad, San Bernardino County, altitude 784 feet, where no measurable rain fell from October 3, 1912, to November 8, 1914, inclusive—a period of more than two years. At Indio, Riverside County, 20 feet below sea-level, no measurable rain fell from November, 1893, to January, 1895, a period of more than a year. At several stations in the Imperial Valley and at one in Death Valley, both of which depressions

are below sea-level, there have been periods of a year in which less than an inch of rain fell.

Snowfall. Since most of the precipitation comes during the winter season, the elevated portions of the state have abundant snowfall. Tamarack, Alpine County (Sierra Nevada), altitude 8,000 feet, has an average winter snowfall of 43.4 feet, based upon a record of eight years. Nearly all of the stations in the higher portions of the Sierra Nevada Mountains receive more than 100 inches of snow every winter. The greatest amount recorded during one winter is 73.7 feet, which fell at Tamarack during the winter of 1906–07. From 40 to 50 feet of snow has been known to accumulate on the ground at one time in the high Sierra Nevada. Professor R. DeC. Ward states:

> The Sierra Nevada Mountains well deserve their name. To them California owes much, if not most, of her present prosperity and her promise for future growth and development. The many feet of winter snowfall which accumulate on the upper slopes mean millions upon millions of dollars each year to the farmers and fruit-growers of southern California. Were all this precipitation to fall as rain, every winter would witness devastating floods, and every summer would wither and destroy the crops.

As may be surmised from the foregoing data, California has a water problem of great complexity. The foundation of it lies in the nature of the precipitation, i.e., its irregular distribution both in time and place. Irrigation, floods, city water supply, and water power are all intimately related subdivisions of the general water problem.

Controls of Water Power. There are five well-recognized factors which control the flow of streams and therefore determine the water-power available at any time. With particular reference to conditions obtaining in California, these are as follows:

1. *Climate:* For California the climatic features here involved and discussed at length in the introductory paragraphs may be summarized thus: deficient precipitation in the lowlands, abundant precipitation (mostly snow) in the mountains, nearly all of it occurring during the winter half-year, while the summer half-year is everywhere dry and hot with excessive evaporation and almost unbroken sunshine. All these features conspire to produce high

water in the streams during the first six months of the year and low water during the latter six months.

2. *Topography:* In contrast to much of the eastern United States the country west of the Missouri is characterized by physiographic immaturity. It is a region of marked topographic contrasts with swiftly flowing streams of sharp gradient and correspondingly high potentialities for power development. The states of Washington, Oregon, and California alone are estimated to have 40 per cent of the developable water-power of the country. Moreover, the collection of water in natural or artificial reservoirs at considerable heights in such a region makes possible the development of power plants where the head or pressure is great.

3. *Underlying Rock:* The permeability of the underlying rock is an important consideration. In the Sierra Nevada Mountains, where most of California's water-power is to be found, the rocks are of great variety, but they are mostly hard granites, more or less impervious to water and not easily eroded.

4. *Vegetation:* Whether or not the headwaters and drainage basin of a stream are forested, determines in large measure the rate of run-off. Generally speaking, when the headwaters of a stream are densely forested the run-off is slow and steady; while, if the forest cover has been removed or the basin is naturally bare of vegetation, the run-off is sporadic, and destructive floods are frequent.

5. *Artificial Agencies:* Reservoirs, either in the form of natural lakes or artificial dams, naturally affect the flow of streams to a large extent. In California there are comparatively few natural lakes of large size along the streams. Artificial dams, however, are numerous and increasing in number from year to year.

Hydroelectric Development in California. The great modern developments of industrial power have been those connected with electricity and oil, and while California is remote from commercial coal supplies, in both of these new sources of power the state ranks high. About 70 per cent of the power used comes from fuel oil and natural gas, and about 20 per cent from water-power. But the oil output will soon have attained its maximum and will begin to decline, and the total power requirements increase from 10 to 15 per cent per annum.

The first hydroelectric plants in California were primarily experiments, and the energy was used locally to operate mills and mining

machinery. The first commercial hydroelectric high-tension transmission in the state was the plant erected in the town of Folsom in 1895. It supplied the city of Sacramento. Since that time development has been rapid. Today 19 power companies operate 80 plants, producing nearly 700,000 horse-power and supplying electrical power to 596 cities and towns.

The progress of electrochemistry and the rapid industrial development of California explain in a measure the rapidly increasing use of hydroelectric power. While agriculture has long been the leading occupation in the state and perhaps will remain the leading one for some time to come, manufacturing is increasing at a more rapid rate than is agriculture. According to the California Development Board, the value of California manufactures has increased from $67,000,000 in 1870 to $750,000,000 in 1917.

Irrigation. Successful agriculture requires that the land shall receive a minimum of 18 inches of water per year. A large part of California—including most of the southern part of the state, all of the San Joaquin Valley, much of the Sacramento Valley, and a portion of the northeastern plateau region—have an average annual precipitation of less than that amount. By means of artificial irrigation, however, much of this land has been reclaimed, and as a result California ranks high in agriculture, particularly in horticulture. The Census of 1910 shows that 39,352 (44.6 per cent) of the 88,197 farms were irrigated. The area irrigated was about 2,664,000 acres. In the 1916 report of the California State Board of Agriculture it is stated that 84 per cent of the irrigation water used in the state came from streams, 13.2 per cent from pumped wells, and only 0.6 per cent from artificial reservoirs.

Water-power and irrigation are intimately related phases of the larger water problem, and neither can be discussed without a reference to the other. In water-power development little or no water is consumed, as it is in irrigation. The power plants simply extract the potential energy of the water as it descends and make no further use of it after it has passed the water wheels or turbines. The power plants are situated in the mountains, while the agricultural fields are in the lowlands and foothills. Hence it would appear that there should be no conflict in water rights. There has been, however, an unfortunate antagonism between users of irrigation water and

power interests, an antagonism which to some extent has delayed water-power development. The ranchmen desire the water to come down from the mountains in large quantities during the dry season, while the power plants can use it only at a regular rate, more or less constant throughout the year.

Flood Control. Though much of the lowland of California has deficient precipitation, it is nevertheless subject to destructive floods. Notable floods occurred along the Sacramento and San Joaquin rivers in 1907, 1909, and 1911, in the vicinity of Los Angeles in 1914, and in the vicinity of San Diego in 1916. The first-named floods were due primarily to warm spells in midwinter, with rain falling in the Sierra Nevada while the ground was deeply covered with snow. The last-named flood was due primarily to excessively heavy rainfall throughout southern California. When it is remembered that most of the heavy precipitation comes within a period of six months and sometimes within a shorter period, the cause of floods can readily be understood; and when monthly and daily excesses of precipitation like those mentioned in the introductory paragraphs of this article occur, it is evident that floods also contribute another factor to the California water problem.

City Water Supply. When cities are small their water needs can easily be satisfied; but when they attain the size of San Francisco or Los Angeles the domestic water supply becomes a matter of considerable importance and involves heavy expenditure. The development of the water supply in each of these cities merits attention.

At the present time San Francisco is constructing at an enormous cost an aqueduct from the Hetch Hetchy district which is designed to deliver by force of gravity a quantity of water somewhat in excess of 400 million gallons daily—under extreme conditions 500 million gallons. When completed, the aqueduct from the intake to the center of San Francisco will be 189 miles long. When construction was begun, in 1912, the city did not propose in the immediate future to build any plant for the development of hydroelectric power. Power development was considered subordinate to domestic water supply. But the city planned carefully to conserve all reasonable opportunities for power development against the time when it would become expedient to use them.

Though at this present moment the aqueduct is not complete, the power is already needed. About one-half of the electric street railway lines in San Francisco are municipally owned, and plans are under way for the purchase of the remaining privately owned lines. Furthermore, an electric street-lighting system is at present being installed which, when completed, will be one of the most efficient in the United States. Municipal needs for electric power have become almost as urgent as domestic water needs. In view of these conditions, a 4,000 horse-power hydroelectric plant was installed on the Hetch Hetchy aqueduct and is already in operation. It is estimated that in three years San Francisco will have surplus power for sale and that the receipts from this source will practically pay interest on the cost of the mountain development of the system.

A few years ago Los Angeles recognized that its future growth was dependent upon an adequate water supply. At huge cost an aqueduct 259 miles in length was constructed to reservoirs in the Owens Valley, near the eastern base of Mount Whitney. In its construction, also, power development was a subordinate consideration, though provision was made for future utilization when the demand should justify the installation of power plants. In 1917 there were three hydroelectric power plants in operation along the Los Angeles aqueduct, and these were capable of generating 40,456 horse-power.

Future Development. The United States Geological Survey is authority for the statement that the water-power in California ranges from over 3,200,000 horse-power at low water to 7,800,000 horse-power at high water. In 1917 less than 8 per cent of the available power was being utilized. There are various indications that this proportion will be materially increased during the next few years. Rapid industrial development, increasing municipal needs of power for electric street and interurban railways and for street-lighting, additional power for pumping irrigation water when no wind is available—all these demand accelerated hydroelectric development. In 1914 there was about 500,000 primary horse-power used in manufactures. It is estimated that the demand in 1918 is about 50 per cent greater. Ocean steamers are given preference in coal deliveries, oil and labor are increasingly difficult to obtain, and the price of

each is steadily rising. Increased hydroelectric development would ease the situation, and the benefits derived would extend beyond the borders of the state.

As water-power consumes no fuel, its substitution for steam power would release to other uses all the extensive transportation facilities now engaged in moving fuel. It would also release a considerable volume of labor which could be used to advantage in other fields. In 1917 there were some 3,000 miles of electric railways in California, the greater porportion of which were operated by hydroelectric power. Eventually all of this mileage and more will be so operated. There were also over 12,000 miles of steam railroads in operation. In time a large portion of this mileage will be electrified. Plans are already under consideration by the Southern Pacific Railroad to electrify its mountain division. The Western Pacific Railroad crosses the Sierras along the Feather River Canyon, at the very edge of a mountain torrent in which more energy goes to waste each year than is generated in all the steam locomotives operated by that company.

The future of water-power development in California, however, is not without its difficulties. Some of the undeveloped power sites are too remote from the market to be utilized at present, and an uncertain number are not yet commerical prospects. The initial cost of installation of a modern hydroelectric plant is relatively high, and for that reason water-power development is necessarily delayed when the demands for capital are so varied and urgent as they are at present. In order to prevent unavoidable interruptions of hydroelectric power an auxiliary steam plant is necessary, and this adds to the cost. For sentimental reasons various waterfalls, which are situated in recreation centers like the Yosemite National Park and are aesthetically beautiful, will not be immediately available for development, but must eventually be put to use. Furthermore, California is a region of frequent earthquake disturbance. Weather Bureau records show that this is the region of greatest instability in the whole United States. However, engineers now take these seismic disturbances into consideration in planning dams and aqueducts, which, as at present constructed, are practically earthquake-proof so far as these frequent but slight disturbances are concerned.

6. THE VALLEY OF CALIFORNIA[1]

The Great Interior Valley of California, which occupies the central part of the state, is almost 500 miles in length with an average width of between 40 and 50 miles, and extends in a general northwest-southeast direction from the city of Redding on the north, to a point south of Bakersfield. It is flanked on its eastern side by the Sierra Nevada Mountains and on its western side by the Coast Ranges. The valley is inclosed around its northern end by the Klamath Mountains, connecting the east-side and west-side ranges, and around its southern end by the Tehachapi Mountains, which likewise may be considered as the merging, in this part of the state, of the Sierra Nevada Mountains and the Coast Ranges. The boundary of the valley on all sides is relatively distinct, but somewhat more so on the western than on the eastern side. The ends are rounded or blunt rather than sharply pointed. The Golden Gate at San Francisco is a break in the Coast Ranges through which the drainage waters find an outlet to the west. However, the bottom of this opening across the mountain ranges is lower than sea-level, so that the sea advances as an arm through the ranges into the valley. The rivers of the valley, therefore, enter the sea within the valley, and do not flow as rivers across the inclosing ranges. Elsewhere the inclosing ranges are practically unbroken.

That part of the Great Interior Valley lying north of the drainage outlet through the Coast Ranges is known as the Sacramento Valley, being drained by the Sacramento River, which enters the valley as a large stream through a gorge in the inclosing ranges at its northern end. The southern and larger part is known as the San Joaquin Valley, and is drained by the San Joaquin River, which is formed largely within the valley by the union of a number of streams from the surrounding mountains, mainly from the Sierra Nevada Mountains. The two main streams mentioned unite just inside the break

[1] Adapted from the following *Reports of Field Operations of the Bureau of Soils*, United States Department of Agriculture: J. W. Nelson, J. E. Guernsey, L. C. Holmes, and E. C. Eckmann, "Reconnoissance Soil Survey of the Lower San Joaquin Valley, California," 1918, pp. 7–17; L. C. Holmes and J. W. Nelson, "Reconnoissance Soil Survey of the Sacramento Valley, California," 1915, pp. 9–15, 147–48; A. T. Strahorn, J. W. Nelson, L. C. Holmes, and E. C. Eckmann, "Soil Survey of the Fresno Area, California," 1912, pp. 2092, 2165–66.

in the Coast Ranges. There is no natural boundary between the two main valleys, as they merge at the confluence of the north and south drainage in a low region belonging as much to one valley as to the other.

The Great Interior Valley consists of a broad, basin-like valley which has been filled to unknown depths by wash from the inclosing mountains. This vast amount of valley-filling material has been deposited by different agencies, operating through long periods of time. It is probable that some of the deposits were accumulated in salt or brackish water, while others were laid down in fresh water. It is likely, however, that most or nearly all of the present surface deposits were distributed across land surfaces as alluvial-fan and flood-plain material by the present streams or their counterparts. It is only along the margins of the valley that consolidated rocks which represent much earlier formations of both sedimentary and igneous character are encountered. The side slopes of the valley have a relatively low gradient and are longer on the east side than on the west, owing to the larger quantities and coarser texture of filling material carried in from the eastern mountains. Regular slopes seldom extend to the trough of the valley, usually being marked in their lower parts by flattened or basin-like surfaces.

Drainage. The drainage of the area is effected by a large number of streams which flow down the valley slopes approximately at right angles to the Sacramento and San Joaquin rivers. The streams of the east side enter the valley through intrenched bottoms or minor alluvial valleys and proceed to the main valley trough without receiving any lateral drainage, while those on the west side are less well defined and have no alluvial bottoms. All of the main streams come from the east side of the valley and pursue rather parallel courses to the valley trough, where they join the main valley drainage. The west side of the valley contributes relatively little drainage, owing to the less extensive watersheds and lower precipitation. In the southern part of its valley the Sacramento is an aggrading rather than an eroding stream. It has built natural levees, therefore, along its banks, which stand a few feet higher than the land back of them and between them and the riverward termination of the alluvial fans built by the streams entering the valley. These low areas are called "basins," the most important being the Sutter Basin, on the east

side of the river south of the Marysville Buttes, the American Basin on the east side just above Sacramento, the Colusa Basin on the west side of the river opposite the Sutter Basin, and the Yolo Basin across the river from Sacramento.

The control of flood waters is one of the most immediate problems in the agricultural development of the Sacramento Valley. Large expenditures have been made in the construction and maintenance of levees, and a fairly efficient system protects much of the valley in years of ordinary or low rainfall. Previous efforts have been somewhat without organization, but comprehensive plans, with consideration for all the complicated factors involved, are now being worked out. Much of the valley floor cannot be farmed because of periodic overflow. In addition to protection from surplus waters, drainage has been supplied to relieve certain soils of sluggish internal drainage. The systems are in most cases effective and of the open-ditch type, drainage water being largely pumped from the area over the inclosing levees. Such drainage will be necessary for other areas of low basin land now being reclaimed from overflow. Water storage in properly placed reservoirs will no doubt aid in the problem of protecting the main valley trough from floods, and many of the valley-slope soils from intermittent overflow.

The lower San Joaquin Valley as a whole has better surface drainage and is subject to less destructive floods than the Sacramento Valley. The poorest-drained parts are the San Joaquin Delta region and the flat region adjoining the trough of the valley, which have slight fall and receive surplus water from both adjacent valley slopes and from the overflow of the San Joaquin River.

The level of the ground water is dangerously high in a large part of the area about Fresno and is still rising in some portions of the irrigated sections. Drainage would remove this danger and aid in the removal of the alkali.

Soil. The soils of the California Valley occur in great complexity. They are closely identified with the various rock masses of the parallel ranges of mountains bordering the valley. The valley has undergone several important transitions which have had an important effect on the soils. They are broadly divided into five general groups. (1) Residual soils from consolidated rocks, largely along the valley margins. (2) Soils derived from old valley-filling material consisting

of the weathered and otherwise altered products of unconsolidated water-laid deposits. These largely occupy positions along the outer valley slopes or rolling areas, at elevations relatively lower than those of the residual soils. (3) Soils derived from alluvial and recent alluvial fan deposits which occupy the lower parts of the valley or the valley slopes now largely within the influence of modern streams. A wide range of soils is found within this province, and upon them the greater part of the intensive agricultural development of the region has taken place. (4) Windlaid soils, which are of moderate extent, but of wide occurrence. (5) Soils of miscellaneous character.

Throughout the California Valley large areas are affected by injurious quantities of alkali. One of the largest areas is on the west side of the Sacramento Valley, in regions of low gradient and stagnated drainage, bordering the "basins" of that locality.

Climate. The climate of this area is characterized by a rainy winter season and a dry summer season. The winter days usually are rainy, cloudy, or foggy and cool, but some bright, warm days are interspersed; the summer is marked by practically cloudless days, low humidity, and high temperature. The winter season commonly is considered as extending from November to April, although there are wide variations in the duration of the rainy period.

Precipitation. The rainfall of the California Valley decreases from north to south, and with minor exceptions is considerably less on the western side of the valley than on the eastern side. The heaviest precipitation occurs in the higher region along the eastern margin of the valley. Red Bluff, in the northern extremity of Sacramento Valley, has an annual rainfall of 24.9 inches; Sacramento at the southern end, 19.28 inches; Stockton, in the northern part of the San Joaquin Valley, 14.57 inches; Fresno in the central part, 10.04 inches; and Bakersfield, in the extreme southern part, 5.39 inches.

The rainfall is well distributed through the winter months, and owing to the gentle manner in which most of it falls, it is nearly all absorbed by the soil, which is moistened to considerable depths where subsoil conditions are favorable. Long-season crops, however, frequently suffer for moisture as summer advances, because of the inability of the soil to retain sufficient moisture from the winter rains to bridge over the dry period.

Snowfall is rare in the area except in the foothill margin, where light and quickly disappearing snows usually occur each season. One or more inches of snow occasionally falls in the northern end of the Sacramento Valley.

Fog is of common occurrence throughout the rainy season in all but the foothill regions. The fog, forming in the night along the lower parts of the valley, often extends well up toward the higher lands and usually continues for sometime after daybreak. Occasionally it persists throughout the entire day, as in the delta region and along the major rivers.

During the summer months the temperatures are high. Temperatures of 100° F. are common, and at practically all points in the valley extremes of 110° to 115° have been recorded. Farming operations are carried on continuously, however, and heat prostrations are practically unknown. This is due to the low relative humidity. The nights are seldom oppressive. Freezing temperatures occur at intervals through the winter months. Light frosts are of common occurrence, and thin films of ice are sometimes formed in the lower portions of the valley. A minimum winter temperature of 20° F. is rare, and a minimum of about 25° F. is unusual. The range of winter temperatures is affected by the elevation and by the movement of air currents. The most severe cold is often experienced along the trough of the valley and in the smaller river valleys, where the local topography restricts the movement of the air. Along the foothill slopes and on the more rolling parts of the floor of the valley frosts are commonly very light, and in exceptional years only is the degree of cold sufficient to affect the growth of the more tender crops. Throughout the winter and spring months there is an abundant growth of vegetation.

Somewhat similar temperature conditions prevail in the Sacramento Valley. However, light frosts and thin films of ice frequently occur during the winter months in the northern part of the valley, while southward the cold diminishes somewhat on account of the greater frequency of fogs. Frosts, destructive to the more tender crops, occur as early as November at times and may continue until early in April, but they are usually confined to the winter months and do not affect the hardy vegetables and truck crops. Late spring freezes are very rare, and damage to early-blooming fruit seldom

occurs in the areas of good air drainage. Among the crops most affected by late spring freezes are almonds, cherries, and apricots.

The average annual temperature for the valley is about the same as in the southern California citrus belt, but the winter temperatures are lower and the summer temperatures higher in the Sacramento Valley. The valley floor, river bottoms, and depressed areas are much more subject to freezes than are the surrounding foothills and lower mountain slopes. The foothill slopes up to about 1,200 feet elevation have a minimum temperature during the winter months of from one to five degrees higher than that over the flatter and lower part of the valley floor. This makes the foothills section a more favorable location for citrus-fruit orchards.

A marked climatic feature of the California Valley are the occasional strong north winds, popularly called "northers." They occur at irregular periods of several weeks and during the summer months are hot, dust-laden, and oppressive. These desiccating winds, when they occur at the time of ripening grain and fruits, result in considerable damage. Considerable loss of moisture occurs from the soil during these winds. The evaporation from plants is also excessive, and vegetation generally has a drooping or wilted appearance. In fall, winter, and spring the northers are cold and disagreeable. These winds attain a velocity of 20 to 25 miles an hour, and blow for periods of about three days.

Agriculture. There is little definite information available with respect to conditions in California prior to 1840. The limited records indicate that there was an Indian population, plentiful game, and a large number of wild horses and cattle. The Indians made no attempt to till the soil, and the Mexicans who succeeded them did but little more, confining their efforts to cattle-raising. The Americans who settled in the valley in the forties engaged in more methodical stock-raising, and during the fifties the production of crops to supply the demands of the miners who had settled in the region was slowly developed. The first efforts in this direction consisted of growing wheat, without irrigation, which largely gave way later to barley, owing to decreases in returns from the former crop. Grain farming in the sixties began to assume an importance equal to that of stock grazing. At this time irrigation began to develop, bringing about a decided change in the character of crops grown and in general

conditions of agriculture. During the seventies several ditch systems were constructed and irrigation farming was extended, and it became apparent this form of agriculture was destined to become the predominant type. As the area irrigated has expanded, a marked diversification of crops and cropping systems has taken place, and the present agriculture includes the production of both general farm crops and many special crops introduced from widely separated districts.

Prior to the settlement and irrigation of this area most of the valley floor was treeless. In the slightly more moist soils of the foothills there were extensive growths of oak, while at higher elevations were pine and similar trees. Along the rivers in the well-watered bottoms sycamore, cottonwood, willow, and oak thrived, and, with the accompanying underbrush and vines, the growth was often so thick as to form dense jungles. The deltas are well watered, and here there was a heavy growth of trees almost dense enough to form true forest. Cottonwood, sycamore, and willow grew close to the streamways, while the intervening lands carried groves of gigantic oaks and a carpet of waving grasses. The combination of feed, shade, and water made this an ideal stock country, and for many years it was devoted entirely to grazing.

At the present time the developed portion of the area is well provided with trees (exclusive of orchard trees), but the non-irrigated portions are still as barren as before the settlement of the country. The roadways are commonly bordered by lines of fig or olive or other trees, which not only afford a pleasant shade during the long, hot summer, but yield a revenue to the owner as well. Eucalyptus and palms are a common occurrence, and some magnificent specimens of these trees are to be found in various parts of the area.

7. FOREST RESOURCES AND THE LUMBER INDUSTRY IN THE PACIFIC STATES[1]

Growth of the Lumber Industry. The development of the lumber industry on the Pacific Coast, our last great coniferous timber reserve, has already progressed far. The first sawmill in the Northwest began operations on Puget Sound in 1845. Within a decade lumber-

[1] Adapted from *Report on Senate Resolution 311*, United States Department of Agriculture, Forest Service, pp. 23–24.

ing became, and still is, the chief industry in western Washington. The cut for a good many years was used locally or shipped into California or exported. Not much timber was cut until after completion of the Northern Pacific Railway in 1882, and then for a number of years only in special grades. Twelve years later lower freight rates were made on eastern lumber shipments and the pronounced development of the west-coast industry began.

Very little lumber was cut in California prior to the beginning of gold-mining in 1849. Lumbering in the redwood belt began about 1860 and grew steadily. In 1899, Washington, Oregon, and California cut a little more than 2,900,000,000 board feet. Production increased slowly until in 1918 the total was slightly in excess of 8,590,000,000 board feet. Washington became the leading state in lumber production in 1905 and has since held this place, except only in 1914, when it fell slightly below Louisiana. The present cut is about 4,500,000,-000 board feet annually. Oregon at present is the third state, with a lumber cut for 1918 of a little more than 2,700,000,000 board feet. That for California has never exceeded 1,500,000,000 feet.

In the twelve years between 1906 and 1918 the cut of the west coast increased only about one and one-third billion feet, largely because of the inability of the product to displace southern pine in the eastern and middle western markets under the handicap of higher freight rates. Within the last year, however, shipments have increased and yellow-pine markets up to the very boundaries of the producing territory have been invaded.

Original and Remaining Forests. The commercial forest area of the Pacific Coast states has been reduced to approximately 57,586,000 acres. A large percentage of this, about 39,370,000 acres, is in virgin stands, not all, however, of accessible high-grade timber, for there is a large percentage of relatively inferior and inaccessible areas. This is an important factor which is usually overlooked in the consideration of the western timber supply. Second growth of saw-timber size covers about 5,292,000 acres, and smaller second growth 6,425,000 acres, while non-restocking areas cover 6,500,000 acres.

Of the volume of the original forest no satisfactory statistics are available. The present stand, however, is about 1,141 billion board feet, or practically half of the remaining saw timber in the United States. Oregon leads with a total stand of 494 billion feet; that

of Washington is 334 billion; and that of California, 313 billion. Six hundred and eighty-six billion, or more than half of the total, occurs in the Douglas fir belt of western Oregon and Washington.

Douglas fir comprises 559 billion feet, and of this 505 billion, or nearly one-fourth of the remaining stand of saw timber in the United States, is in Washington and Oregon. Estimates by species are as follows:

	Board Feet Lumber Scale
Douglas fir (western Washington and Oregon)	558,571,000,000
Western yellow pine and Jeffrey pine	183,453,000,000
Western hemlock (largely in western Washington and Oregon)	94,000,000,000
True firs	82,479,000,000
Redwood (California Coast Range north of San Francisco)	72,208,000,000
Sugar pine and western white pine (largely sugar pine, Sierra Nevada Mountains in California)	38,485,000,000
Western red cedar (western Washington and Oregon)	49,000,000,000
Spruce (Washington and Oregon)	13,355,000,000
Lodgepole pine	4,566,000,000
Others	44,914,000,000
TOTAL	1,141,031,000,000

The total area cut over is approximately 6,125,000 acres, of which two-thirds is in Washington and Oregon, and a very large percentage west of the Cascades in the Douglas fir belt. As already indicated, the total non-restocking area of the Pacific Coast states is estimated at 6,500,000 acres, but this is only a part of the sum total of depletion, since there has been great and needless loss from the destruction of virgin stands by fire and other causes on a part of the 6,425,000 acres now supporting second growth. The area burned over annually in these three states is shown by Forest service data to amount to 450,000 acres, and the loss in timber to about 600,000,000 board feet.

Logging operations are now removing annually a little less than 2 per cent of western Washington's timber and less than 1 per cent of western Oregon's timber. Yet the reasonably accessible timber and that in private ownership is going very much faster, and with decreasing southern pine production enormous pressure to increase the cut may be expected.

The situation in Grays Harbor County illustrates the rapid exploitation which in a surprisingly short time is to end the industry locally. About twenty years ago there were in this county 750,000 acres of timber and only about 75,000 acres of cuttings. Now there are 355,000 acres of stumps. One-sixteenth of the county's private timberland is being cut over annually. In twenty-five years the supply of privately owned virgin timber will be gone.

King and Snohomish counties, Washington, the scene of the earliest lumbering operations in the Northwest, also illustrate local exhaustion of virgin timber in the not very remote future. Forty billion of the original eighty billion of feet of commercial timber has been cut. Thirty billion of the remainder is in private ownership, and is now being felled at the rate of 800,000,000 feet annually. Indications are that this private timber will be gone in about thirty-five years.

The factor of local consumption must also be considered. California is an example. Its industry is large and promises to grow. From the earliest days California has been an important source of export material. Large quantities are still exported to the East and to foreign countries; but up to the present time the state's population and agricultural and industrial development have more than kept pace with the output of lumber, so that it is doubtful whether production has exceeded consumption since 1875. From the beginning of lumbering on Puget Sound, California has imported large amounts of fir. The per capita lumber cut of the state has been approximately equal to, or slightly in excess of, the average per capita consumption of the United States since between 1869 and 1879, while the average consumption of the state is probably somewhat greater than for the country as a whole. In 1910, southern California alone used the equivalent of about half the total cut of the state, a per capita consumption of at least twice that of the whole United States.

CHAPTER XIII

THE PRINCIPAL GEOGRAPHIC DIVISIONS OF MEXICO[1]

By Alice Foster

Mexico is a land of contrasts—topographic, climatic, and industrial. So great are these contrasts that few generalizations can be made about the country as a whole or about the people as a group. The climatic contrasts are in part the result of topography, and the industrial contrasts are due largely to physical conditions, among which topography and climate are particularly significant.

Various conditions combine to give Mexico a striking assembly of topographic and climatic contrasts. The country occupies a complete east–west section across the continent and includes within the space of some 500 miles Gulf Coastal Plain, east-facing mountain slope, plateau, west-facing mountain slope, and Pacific Coastal Plain. While the latitudinal extent of 17° is equal to about two-thirds that of the United States and involves rather wide climatic differences, the contrasts due to topography are much more striking. In everyday conversation as well as in scientific writing, the Mexicans use the expressions *tierra caliente* (hot country) and *tierra fria* (cold country) as regional terms to designate respectively the tropical lowlands and the mountain slopes and plateaus above the frost line. There are marked differences in the amount and character of precipitation and in its distribution throughout the year. The annual precipitation varies from more than 100 inches on the Gulf slope of the highland in southern Mexico to approximately 3 inches in the Colorado Delta. Southern Mexico has a distinct rainy season from June to October, characterized by heavy downpours coming as daily convectional showers; but the higher Gulf-facing slopes east of Mexico City have, in addition to this rainy season, a season of fine, drizzly rains lasting throughout the winter. In Northern Mexico the scant precipitation comes as infrequent violent showers.

[1] Written for this volume. Miss Foster is assistant professor of geography at Mount Holyoke College.

Conditions of surface and climate are grouped in various combinations and associated with other physical conditions, such as depth and richness of soil, extent and nature of water resources, the presence of forests or grass lands, and the existence and accessibility of useful minerals. While the grouping of factors varies, in some respects, even within narrow limits, yet commonly a single factor or group of factors is so significant and far-reaching in its effects as to establish essential unity of the physical environment over wide areas.

In harmony with the chief characteristics of the physical environment, industries, social customs, density of population, and political relations vary greatly in different parts of the country. In the northwest there are arid plains where the few inhabitants eke out a scanty subsistence; farther east there are grassy plains which furnish pasturage for immense herds of cattle, and along the Gulf coast there are humid plains whose fertile soil and high temperature fit them to be richly productive agricultural areas. The western highlands have abundant rainfall, but their surface is so rough and the valleys are so narrow that few people live there; in the eastern highlands, although the surface is rough, certain valleys with rich soil support a dense agricultural population; and the highland about Mexico City, because of level surface, fertile soil, geographic position, and valuable mineral resources, is the most densely populated part of the country. On the Gulf-facing slope of the highland there are mountain districts where power resources and ready access to the outside world have led to the development of large-scale manufacturing industries, and where the natives, through contact with people from abroad, have lost many of those provincialisms and primitive arts which travelers are fond of describing; and in the highlands of the south and west there are other mountain districts where, because of extreme isolation, quaint old customs are kept up, the most primitive apparatus is in use, and the people have never learned the Spanish language. There are districts intimately connected with Mexico City, the political and commercial center of the country, by railway, telegraph, and telephone service, so that the larger business transactions are carried on through the wholesale, importing, and banking firms of the capital; and there are outlying districts so isolated from the chief centers of Mexican population by barriers of mountain country, sea, desert, or impenetrable tropical forest that the people scarcely consider

themselves Mexicans, and that such commercial relations as exist are chiefly with some outside country.

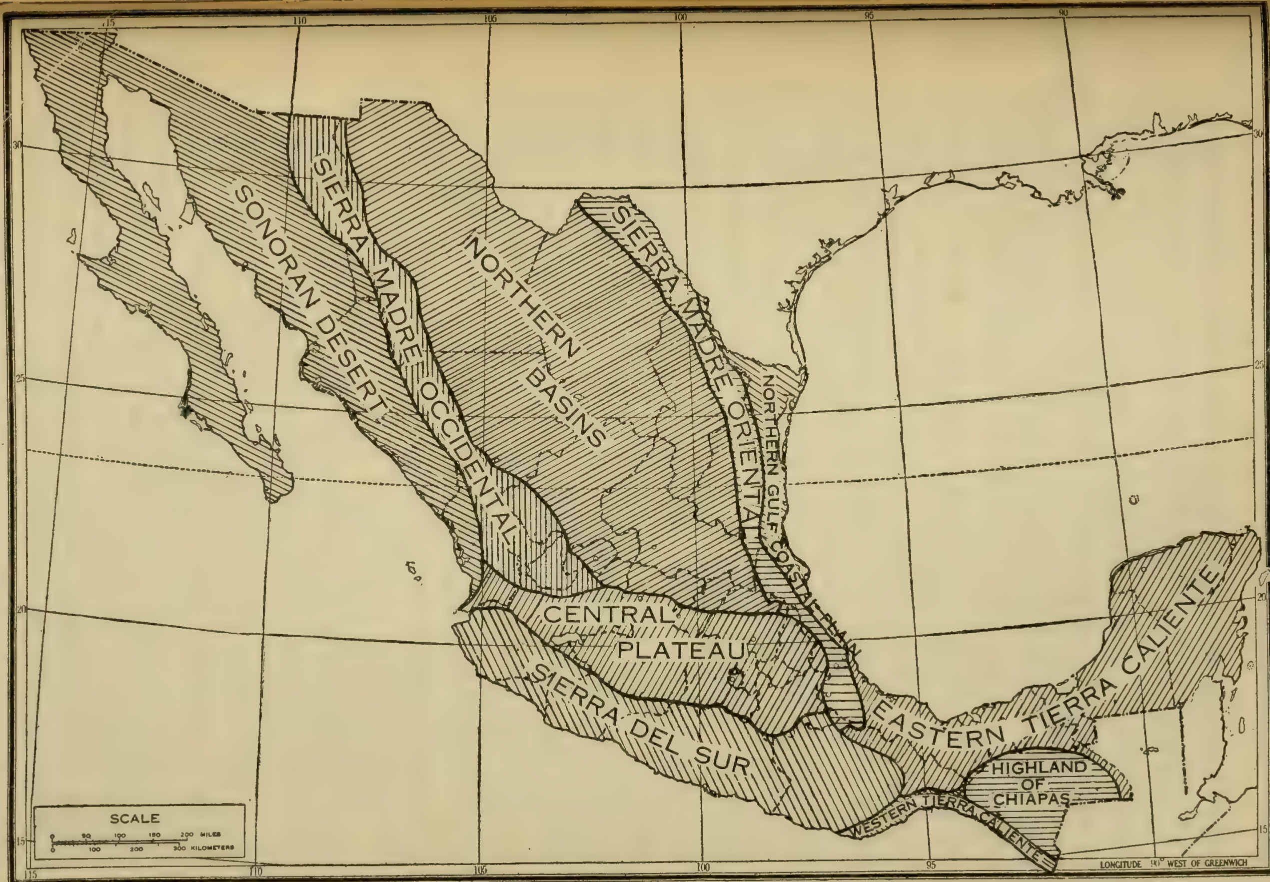
Because of these contrasts, an adequate study of Mexico must be based upon a realization that in the various sections of the country different forces have influenced human interests and activities and that the problem of adjustment to environment has been different for each section. Considering the more important contrasts and similarities in the physical environment and the resulting contrasts and similarities in human interests and activities, it is convenient to recognize the following major geographic divisions:

1. The Sierra Madre Occidental (the Western Sierra Madre)
2. The Sonoran Desert
3. The Central Plateau
4. The Sierra Madre Oriental (the Eastern Sierra Madre)
5. The Northern Basins (the Chihuahua Semidesert)
6. The Northern Gulf Coastal Plain
7. The Eastern Tierra Caliente (East-Coast Hot Country)
8. The Western Tierra Caliente (the Pacific Valleys and Coastal Plain)
9. The Sierra del Sur (the Southern Sierra)
10. The Highland of Chiapas

1. THE SIERRA MADRE OCCIDENTAL

The Sierra Madre Occidental includes the belt of narrow plateaus and mountains extending southeastward from the International boundary in Sonora and Chihuahua to approximately latitude 21° N. where it merges into the volcanic province of Mexico. The southern boundary is formed by the canyon of the Rio Grande de Santiago. The region consists of a series of elongated high plateaus trenched by deep canyons and bordered on the east and west by mountains somewhat lower than the plateau level. The plateaus are remnants of a vast lava plain, beneath which older mountains were buried so deep as to obscure the trend of ranges. In the mountainous borders, which are the dissected edges of the plateaus, the lava cover is removed, or remains only in irregular fragments, and deep valleys are cut into the underlying older rocks.

The eastern mountain border is narrow and rises abruptly to altitudes several thousand feet above the grassy plains which border the Sierra belt on the east. The stream valleys in this section are narrow canyons 1,000 feet or more in depth, with valley flats developed



Map 10.—Major Geographic Divisions of Mexico

only as narrow and discontinuous strips. The streams dwindle in volume after leaving the mountains, and most of them disappear near the western border of the plains. The western border of the Sierra region is a wild and rugged mountain belt with a precipitous descent to the desert lowlands at the north or the narrow Pacific Coastal Plain at the south. This mountain belt consists for the most part of lateral valleys and spurs, the former deeply incised into the plateau, the latter projecting toward the coast, in many places—particularly near the southern end of the region—almost reaching it.

The Sierra Madre Occidental is of significance to man in several distinct ways. The mineral wealth of Mexico is closely associated in origin with the history of the Sierras. Ages ago, during the period of lava flows, the older mountains were enriched with veins of silver, copper, lead, gold, and other metallic ores. These ores have been mined since the time of the Spanish Conquest and are today one of the principal considerations in the mind of the American business man when he speaks of Mexico as a "land of great opportunities." In the plateau belt the mineral treasures are buried hundreds of feet deep, but in the mountain borders the deeply incised valleys have rendered the ores accessible. Rainfall in this upland region is sufficient so that the plateau summit and the upper mountain slopes have fine, open forests of pine, oak, and cedar with grassy forest floors. These forests furnish an invaluable supply of construction timber for the mining districts, and the streams which rise in them supply the water essential for the mining camps and towns and for irrigation in the lower reaches of the valleys and on the arid plains which flank the western Sierras.

The Sierra Madre Occidental is a formidable barrier. The steep gradient and bowlder-strewn beds of the marginal valleys, the high altitude and the rough lava surface of the plateau belt tend to repel rather than invite human occupation. In addition, the valleys are so young that in only a few places along their courses are there strips of alluvium suitable for cultivation. Consequently it is a region of sparse population with few and difficult routes of communication, and with little promise of local traffic to encourage the building of roads except to the mining camps. Its barrier nature has hindered greatly the development of the Pacific valleys and Coastal Plain, whose best route to the markets of the interior of Mexico leads at

present north by rail to the United States, thence east over the Southern Pacific Railway, and back into Mexico by the Mexican Central. Railroads extend parallel to the Sierra belt on the east and west, and branch lines extend from these to the mining camps in the mountain borders, but not a single line has been completed as yet across the Western Sierra to the coast. The only line connecting the interior with the Pacific Coast lies south of the Sierra Madre Occidental and has its terminus at Manzanillo, Colima.

2. THE SONORAN DESERT

The Sonoran Desert occupies a wedge-shaped portion of northwestern Mexico, including most of Lower California and extending as far south as the state of Nayarit (formerly the territory of Tepic). The region is a broad, shallow trough bordered by the foothills of the Sierra Madre Occidental and the low mountains which form the axis of the peninsula of Lower California. The deepest part of the trough is covered by the waters of the Gulf of California, from which the ascent is abrupt to the range on the west. The broad plain which slopes seaward from the Sierras is interrupted by scattered northwest-southeast-trending ranges, which, like the bordering mountains, are composed of crystalline rock. The steep slopes of these ranges rise abruptly from the parched, sandy plain and give the impression of lost ranges "buried to the ears" in the desert sand. In reality, the crystalline rock is continuous from range to range beneath a comparatively shallow layer of marine sediment and torrent-spread alluvium.

Desert conditions are particularly extreme in the northern part, and between the Colorado and Yaqui rivers, a distance of 500 miles, no stream ever reaches the sea. Some intermittent streams rise in the Sierras, rush violently down the steep slopes during the midsummer and midwinter rainy seasons, and spread out into torrential sheet floods upon the desert plains, only to be absorbed well back from the sea by the parched air and sand. Farther south, the bordering Sierras are higher and the rainfall is somewhat greater, so that some of the streams have sufficient volume to reach the sea. In the lower reaches of the valleys and on their alluvial fans agriculture is possible, for, even though the stream be intermittent, the porous alluvium stores up the storm water brought down from the mountains. Irrigation is practiced in a number of places and is possible in many others

at relatively small expense. Since this part of the coast has direct railroad connection with the United States, the raising of early fruits and vegetables under irrigation for American markets is a promising industry.

While the Sonoran Desert as a whole is capable of supporting only a sparse population, there are certain favored areas whose economic possibilities have attracted capital from abroad. Among these are the prosperous irrigated district of the Colorado Delta, and the copper-mining districts of Santa Rosalia and Cananea, in Lower California and Sonora respectively.

3. THE CENTRAL PLATEAU

The Central Plateau occupies the part of the Mexican highland which has been the center of human interest throughout historic times. The highland of Mexico rises gradually from the Rio Grande on the north to a maximum elevation in the Mexico City section, where the eastern and western mountains approach each other. This highest part of the highland, with an altitude some 5,000 feet greater than that of El Paso (3,370 ft.), is the Central Plateau. It consists of a group of extensive lacustrine plains (*los Llanos*) inclosed by volcanic ranges and peaks, some of the peaks rising to more than 10,000 feet above the level of the Llanos. The sedimentary filling of the basins is volcanic ash and rock waste from the neighboring mountains, and was laid down in the great water bodies which once occupied the basins. Lake Texcoco, Lake Chalco, and numerous small lakes and swamps are remnants of the former extensive lakes.

The more elevated of these plains are some 7,500 feet above sea-level, hence they have the climate of low-latitude highlands. There is marked periodicity in rainfall, most of the annual precipitation coming in daily convectional showers from June to October. During the cooler months light frosts are common, and snow is not unknown. Temperatures are relatively low throughout the year, making sunny rooms desirable. The daily range of temperature is high, and even in July the night and early morning temperatures are decidedly chilly, especially to one accustomed to a middle-latitude climate. There is a marked temperature contrast between sunshine and shadow. While surfaces exposed to the sun's rays become intensely hot, it is always cool in the shade. Atmospheric humidity is low, and evaporation is rapid.

Soil, surface, and climate upon the Central Plateau are relatively favorable for agriculture and stock-raising. The lacustrine sediments are deep and fertile, the sunlight is intense, the rainfall is concentrated largely in the warmer season and irrigation is possible in many places. Wheat, maize, and barley are important crops in the level sections, the maguey is grown upon the mountain slopes as well as on the Llanos, and large quantities of truck products are produced by irrigation.

Since the Spanish Conquest, mineral resources have been an outstanding feature of the physical environment in the Central Plateau. Igneous and metamorphic rocks of several geological ages outcrop in the numerous mountain ranges which characterize its surface. Gold and silver are the most important products, and the mines at Pachua in the state of Hidalgo, Guanajuato in the state of the same name, and Real del Oro in the state of Mexico are among the historic mining districts. These and other districts have furnished markets for agricultural products and manufactured goods and in many ways have contributed notably to the industrial development of the country.

In a number of Plateau cities important manufacturing industries have grown up in recent years, attracted by the advantage afforded by the market and labor supply in the densely populated section, although in many cases the power for the factories is developed in the Sierra Madre Oriental beyond the border of the plateau. Among the more widely known of the factories are the Puebla cotton mills, the Toluca brewery, and the woolen mills, cotton mills, and breweries of the City of Mexico.

On account of these economic activities the Central Plateau is the most densely populated part of Mexico. At present, although it constitutes only one-sixth of the total area of the country, it has two-thirds of the cities and nearly two-thirds of the total population.[1] As a result the City of Mexico, which dominates the region, is the railway, commercial, financial, and cultural center of the Republic.

4. THE SIERRA MADRE ORIENTAL

The Sierra Madre Oriental is a belt of folded mountains extending along the Gulf Coast from near the Rio Grande to Oaxaca. The mountain belt is narrow, and increases in altitude from north to

[1] S. W. Cushing, "The Distribution of Population in Mexico," *Geographical Review*, April, 1921, p. 234.

south. This Sierra differs from the Sierra Madre Occidental in being less elevated, except in the southern part; in being composed chiefly of sedimentary rocks, dominantly limestone; and in being, in general, a less formidable barrier. The slopes are rounded, and since the rainfall is abundant, they are forested.

The region is in topographic maturity, hence agricultural land is limited to the narrow valley bottoms. The warm temperature, the abundant rainfall, and the high quality of the alluvial soils derived from the limestone hills make these valley farms richly productive. From the forested slopes are obtained construction timber and wood for charcoal, which is the household fuel in general use. Numerous waterfalls, especially east of Mount Orizaba, form a valuable power resource, a small part of which is utilized for lighting the cities of the region and as a motive power for factories located in these cities and on the Central Plateau. The most important of these factories are the textile mills of the Orizaba district.

5. THE NORTHERN BASINS. THE CHIHUAHUA SEMI-DESERT

The region of the northern basins occupies the extensive area of semi-desert plains and scattered ranges lying between the Eastern and Western Sierras. It is related to the Sierra Madre Oriental in that the ranges in both regions are of sedimentary strata, folded, faulted, fractured, and affected by many igneous intrusions. The two regions differ in the character of the intermontane areas and in the external characteristics of the mountains. While in the Sierra region the rounded slopes are forested and are separated by narrow valleys, the basin region is characterized by broad lacustrine plains or bolsons, above which rise the unburied summits of rugged and barren desert ranges, completely isolated from each other by the sedimentary fill. The rainfall is scant and evaporation rapid, so that most of the streams which rise in the Sierra Madre Occidental are lost in the sand of the bolsons within a short distance of the mountains. However, the Rio Conchos flows across the state of Chihuahua and joins the Rio Grande, and a number of streams empty into salt lakes in the central part of the region. Important among these are the Rio Nazas and Rio Nievas which furnish irrigation water for the Laguna district.

This region has never supported a dense population, but it has economic possibilities which, under scientific management, are con-

siderable. The scant rainfall has a decided summer maximum, so that the broad plains are covered with grass which furnishes excellent pasturage for range cattle. In some portions, as in the Laguna cotton district and near the Rio Grande, water is available for irrigation, and agriculture is important. A greater development of irrigation seems probable for the future. The construction of storage reservoirs along the eastern border of the Sierra Madre Occidental will conserve a greater supply of water. Moreover, the bolsons themselves serve as enormous reservoirs, in which is stored water supplied by the rainfall, by the run-off from the neighboring ranges, and by streams which rise in the Western Sierras. In many places the water table rises to within a few feet of the surface[1] (6–30). In such places the ground water may be utilized for irrigation by pumping from common wells if economic conditions warrant, and in a few places there is a possibility of securing water from artesian wells. The mining districts of Chihuahua and Zacatecas are in the Basin region, as is also the Sabinas coal field of Coahuila. Because of the north–south trend of the desert ranges, and because of the regular surface of the intervening plains, the railroad routes connecting the City of Mexico with the United States border extend through this region, furnishing transportation for the grazing, agricultural, and mining sections.

6. THE NORTHERN GULF COASTAL PLAIN

The Gulf Coastal Plain of Mexico is a continuation of the same feature in Texas. The northern and southern sections are separated by the near approach of the mountains to the sea between Veracruz and Tampico. The northern section is largely outside the belt receiving tropical rains, and while the rainfall is ample, its distribution is irregular. This region has great agricultural possibilities, but the chief commercial interest at present centers about the petroleum district of Tampico and Tuxpan.

7. THE EASTERN TIERRA CALIENTE

The Eastern Tierra Caliente embraces the tropical lowlands occupying the southern part of the Gulf slope of Mexico. It includes the following units: (1) the Gulf Coastal Plain south from Veracruz;

[1] Juan D. Villarello, "Hidrologia de la Comarca Laguneta del Tlahualilo Durango," *Parergones del Instituto Geológico de México*, Vol. III, Plate XLV.

(2) the peninsula of Yucatan; (3) the basin of the Papaloapan River; and (4) the lowlands of the Isthmus of Tehuantepec.

In general, the Eastern Tierra Caliente consists of low-lying fertile plains sloping gently seaward. The coastal margin is bordered by sandy bars, lagoons, and mangrove swamps. Numerous valleys, cut into the slope of the highland, carry the conditions of the Tierra Caliente beyond the limits of the Coastal Plain. The most conspicuous example of this is the Papaloapan River, whose upper basin is bounded by the Sierra de las Mixtecas and the southern border of the Central Plateau. This river is navigable for small boats far into the interior.

In this region high temperatures are continuous throughout the year, and atmospheric humidity is high, so that much of the area supports a tropical forest, particularly along the streams, where the undergrowth is so dense as to be almost impenetrable. The forests yield valuable woods, gums, and extracts, their exploitation being made possible by the numerous navigable streams. The cleared lands produce bountiful crops of rice, sugar cane, tobacco, and bananas. In some of the more elevated and less humid portions of the region, there are extensive savannas which form the basis for an important cattle industry.

The economic possibilities of this region are great, and await only a wise and stable government to be realized. Before the revolution much foreign capital had been invested in sugar, rubber, and tobacco plantations and the region was developing rapidly. It is more favorably situated, so far as transportation facilities are concerned, than any other part of tropical Mexico. It has numerous rivers navigable for small boats. It has railroad connections with the important port of Veracruz at which practically all boats entering the western Gulf call. It has therefore great advantages in reaching American markets which demand an increasing amount of tropical produce. It has railroad connections also with the Central Plateau which is the great Mexican market, and where tropical fruits are not produced.

The northern part of Yucatan differs greatly in its outstanding characteristics from the rest of the region. The northern part of the peninsula has a light rainfall, is floored with limestone, and has underground drainage, which conditions combined make an extremely

arid environment. In this environment the henequen flourishes and forms the basis of the sisal industry which makes this section one of the most prosperous areas of Mexico.

8. THE WESTERN TIERRA CALIENTE

This region includes the Pacific Coastal Plain and the valleys of streams tributary to the Pacific in the states of Chiapas and Oaxaca. Many of the characteristics of the region are similar to those of the Eastern Tierra Caliente, but there are significant contrasts. Location on the leeward coast causes the dry season to be more pronounced, and the drought hazard is greater. Agricultural land is confined chiefly to the valleys, which, because of the rough country back from the coast, and because of the narrowness of the Coastal Plain, are largely isolated from each other and from the interior. Difficulties of communication are increased by the fact that the streams, except for their short lower courses across the narrow coastal strip, are flowing through mountain country, and hence are not navigable. As a result of these conditions, the Western Tierra Caliente is cut off very largely from the important Mexican markets, and the commercial outlook is to the Pacific. However, the Tehuantepec-Chiapas section of the Coastal Plain has railroad connection with the Tehuantepec route and an outlet by the port of Tonala.

9. THE SIERRA DEL SUR

A complex mountain belt known as the Sierra del Sur borders the Pacific south of the Central Plateau and ends abruptly in the state of Oaxaca in a steep escarpment overlooking the Isthmus of Tehuantepec. It differs from the Sierra Madre Occidental in that the trend is more nearly east–west, and in that the superficial volcanic material has been removed to a greater extent. Near its eastern extremity it is connected with the Central Plateau by a north–south mountain bridge extending from Oaxaca to the volcanic range south of Puebla. This bridge is the Sierra de las Mixtecas, which forms the continental divide in this part of Mexico. The region of the Sierra del Sur, which is bounded by the Central Plateau on the north, the Sierra de las Mixtecas on the east, and the Pacific Coastal Plain on the south, is the most highly dissected part of Mexico. The

mountains, whose summits reach an altitude about equal to that of the Llanos of the Central Plateau (about 7,500 feet), have been carved out of a former plateau by the development of a complicated system of valleys tributary to the Balsas. The main stream has cut a deep channel through the mountain barrier and empties into the Pacific.

The great handicap of this region is the difficulty of communication. This fact is illustrated by the situation of the port of Acapulco which for a distance of 500 miles along the Guerrero-Oaxaca coast is the only regular port of call for steamers. It has an excellent harbor, formed by a spur from one of the ranges. The Acapulco harbor has the great advantage of freedom from the shifting sands characteristic of harbors situated at the mouths of the heavily loaded Mexican rivers, but the growth of the port has been hampered by the presence of the mountain barrier separating it from the interior. Through this mountain barrier no railroad has been built from the interior to the coast. In a similar way, difficulties of transportation have hindered the utilization of the rich mineral resources of the region. Railroads are absent and navigation of the Balsas River is interrupted by numerous rapids. However, in the northern part of the region one of the national railroads connects Manzanillo, in the state of Colima, with the Central Plateau.

10. THE HIGHLAND OF CHIAPAS

The highland of Chiapas is the forked end of the Central American mountains, which extend into Mexico from Guatemala and terminate at the Isthmus of Tehuantepec. They have a general east-west trend, and increase in altitude from west to east. The southern range, which is known as the Sierra Madre de Chiapas, forms the continental divide. The Pacific slope is steep, since the principal summits rise to altitudes above 9,000 feet within 30 miles of the coast. The Central Highland, which consists of sedimentary folds and volcanic masses, is separated from the southern range by the valley of the Chiapas River, a tributary of the Grijalva.

The slopes of both ranges are forested—tropical hardwoods at the base, and forests of oak and pine extending up to altitudes of 10,000 or 12,000 feet, above which are savannas. The Chiapas Valley, whose elevation is 1,500 to 3,000 feet, is a dry savanna area.

The inhabitants of the Chiapas Highland are engaged chiefly in agriculture, which shows a horizontal zonation from the cacao-producing lands of the lower Pacific slopes through the coffee zone to the wheat districts of the drier central uplands and the slopes of the volcano of Tocana above the altitude to which most of the clouds ascend. The savannas of the Chiapas Valley are the seat of a considerable stock-raising industry. Formerly this district was a large producer of indigo, and this commodity is produced still to supply the local demand.

The Chiapas Highland is one of the more isolated parts of Mexico. Dense tropical forests act as a barrier on the north and west, and the scant commerce is directed largely toward the neighboring republic of Guatemala. Spinning, dyeing, and weaving, as well as the cutting of stone and the making of pottery, are carried on by primitive methods, and many of the exports to Guatemala are of articles demanded by the native races of that country.

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CHAPTER XIV

ASPECTS OF MEXICAN GEOGRAPHY

1. LOWER CALIFORNIA (SONORAN DESERT)[1]

The peninsula of Lower California is 750 miles long and from 30 to 150 miles wide; the north, in most aspects, is similar to southern California. Rocky mountains, barren hills, and stretches of desert predominate, but there are some fertile valleys. The southern part of the peninsula has more rain, is fertile, and sub-tropical products are grown.

Owing to the widely scattered ports, no official figures are available for the imports and exports of Lower California except for the port of Ensenada which is 65 miles from San Diego by sea. Most of the imports originated in the United States at the ports of San Francisco, Los Angeles, and San Diego, and consisted principally of groceries, liquors, camp supplies, general merchandise, gasoline, and kerosene. The few remaining imports came from the mainland of Mexico and consisted mostly of coffee, cigars, and cigarettes. The principal exports were fish, wheat, fruits, bird guano from the coastal islands, and copper, all going to the United States. Considerable flour was sent to Mazatlan.

Wheat is grown in the northern valleys by Russian colonists, but its export is restricted, and most of it is milled locally or is shipped to Mazatlan or other Mexican ports on the west coast. The soil is particularly adapted to bean-growing. In the southern district early vegetables for American markets, grapes, oranges, lemons, limes, tangerines, olives, and dates are grown. Around all the towns Chinamen raise vegetables for home consumption.

The country is rich in gold, silver, copper, lead, zinc, and iron. Magnesite is shipped from Magdalena Bay; the Mexican onyx quarries near Santa Catarina are the largest in the world. An immense surface deposit of iron ore at San Isidro gives much promise.

[1] Adapted from W. C. Burdett, *Supplement to Commerce Reports*, June 21, 1920, pp. 4–7.

Since 1911 mining has been on a decided decline, the one exception being the El Boleo copper mine at Santa Rosalia, where a French company has produced steadily and successfully for a number of years. The company has its own smelter and operates its own ships.

There is no readily accessible timber on the peninsula, but in the higher altitudes back from the coast there are immense pine forests. These will not be available until railroads are built. There are no sawmills and the small amount of lumber used is shipped from the United States.

No water-power is utilized, although several streams, notably the Santo Domingo River, which falls some 4,000 feet from the sides of San Pedro Martir Mountain, are capable of developing power. It is inevitable that some time in the future hydroelectric power plants will be erected on these rivers. The more important of these streams have been nationalized.

At one time about 50,000 cattle were grazed in the northern district, but this number has been reduced to less than 20,000 head. The largest cattle-owners are Americans, and they have been steadily retrenching. It is claimed that 200,000 cattle could easily be grazed in this district.

Fishing is one of the most important industries, and the waters off both coasts of Lower California abound with edible fish. No fish from the Gulf of California are taken to the United States, but a large portion of the fish consumed in the Pacific Coast states comes from Mexican waters off the west coast of Lower California. Often the market does not absorb the catch, and much fish is sold for fertilizer, or thrown away.

Poor highways have adversely affected the development of the territory and accentuated its isolation. The governor is undertaking a program of road improvement, and at various points highway construction is under way. An automobile highway connecting Ensenada with San Diego probably will be completed in 1920, and preliminary work is in progress to extend this road 200 miles farther south.

There are no railroads except a short stretch of the San Diego & Arizona, which in two places passes just inside the border and has no economic effect on the main part of the district. A large part of the territory is inaccessible except on foot, or, at best, with pack

mules or burros, and the few highways are little used except for passenger traffic. Practically all the trade is sea-borne. There is telegraph service between the larger towns and there are three wireless stations, all controlled by the government. No express companies have service in Lower California.

The population of Lower California, exclusive of the Mexicali district, is probably about 39,000, of whom 32,000 live in the southern district. No exact figures are available. The American population is less than 200, and there are less than 100 British, French, Italians, and Germans. The bulk of the Chinese population is in the Mexicali district and not over 600 live in the territory under consideration. No Japanese live in the territory except the fishermen in the camps on the Pacific Coast, the last count on these being 85. It is stated that no land is owned by the Japanese.

The Copper Mines of Santa Rosalia.[1] The Boleo copper mines are located on the Gulf Coast of Lower California, in Santa Rosalia, in the southern district of the territory, the latitude being 27°19′N. They are situated at a distance of about 60 miles from the port of Guaymas, Sonora, which has communication by the Southern Pacific along the coast with the port of Mazatlan and with the United States. In addition, Santa Rosalia has maritime connections with various ports of the Pacific, both Mexican and foreign. The company maintains its own fleet of steamers.

The old roadstead of Santa Rosalia has been converted by the copper mining company into an artificial harbor which has safe anchorage for vessels of deep draft. The harbor is inclosed by sea walls, giving an anchorage ground of about 40 acres. The port has a customhouse and warehouses. The smelter is located on the margin of the sea at Santa Rosalia, and has communication with the various mining camps by means of three narrow-gauge railroads, whose united length is 28 miles. The sanitary conditions of the city are not entirely satisfactory, since the topography of the region makes difficult the establishment of a sewage system. Drinking water is brought by a 6-inch iron pipe from Santa Agueda, some 23 miles distant.

[1] Adapted by Alice Foster from Leopold Lopez and Luis C. Espinosa, "El mineral de 'El Boleo' en Santa Rosalia, Baja California," *Boletín minero*, Mexico, Departmento de Minas, V, 303–11.

The climate of this district is hot and the humidity is high. Rains are scant. The time of greatest heat includes the months of July and August. The prevailing winds are northwest.

The concession for the opening of the Santa Rosalia mines was granted with the understanding that there should be an attempt to colonize the district. Up to the present no colony has been established. The city of about 11,000 consists of groups of miners who are entirely dependent for work upon the copper mining company, since the region has no natural resources other than those which lie beneath the surface. In fact, the district is entirely lacking in the elements necessary for life, since outside of a few cereals and fruits and some cattle from Mulegé, San Ignacio, and the states of Sonora and Sinaloa, everything consumed by the mining population is imported from the United States. They are even more dependent upon the outside for materials needed in the exploitation and treatment of minerals, such as machinery, explosives, fuel, wood, fluxing materials, chemicals, etc. Even wood for domestic fuel must be brought from places more or less distant.

2. THE ECONOMIC SIGNIFICANCE OF THE COLORADO DELTA (SONORAN DESERT)

a)[1] In agricultural possibilities the delta of the Colorado is undoubtedly the most important section of the Sonoran Desert, because of the extent of its area, the quantity of water available for irrigation, and the exceptional climatic conditions. Because of the geographic position which it occupies, being only a portion of a natural province whose greater part belongs to the powerful northern neighbor, and being isolated completely from the rest of the inhabited portion of the Republic, this region, so far as its utilization is concerned, constitutes one of the most difficult problems of the Department of the Interior.

The general aspect of the delta is that of an immense plain in which there is not noted any appreciable variation in level except near its borders or where there are small mounds of dune sand. Irregular channels cross the plain in many directions, in some cases occupied by streams, in others by ponds of stagnant water, and in many more cases entirely

[1] Adapted by Alice Foster from *Parergones del Instituto Geológico de México*, IV (1912–13), 186–233.

dry and crossed by other more recent channels. The rich alluvial soils of this district have been derived from the decomposition of rocks throughout the enormous drainage basin of the Colorado.

Like other desert regions, the Colorado Delta has a large range of temperature, the summer maximum being the highest recorded in America and the minimum temperature in January and February descending to below freezing. Atmospheric humidity is extremely low. Showers are infrequent, and the annual rainfall is about three inches; hence agriculture is possible only under irrigation. The prevailing winds are from the west and northwest and are strong enough to cause disagreeable sand storms.

Upon the Mexican side of the international boundary the principal products are alfalfa and barley. There are immense areas where these crops are cultivated for fodder. The soil is productive, water is abundant, and not much cultivation is required. Direct export of these products is of importance only when scarcity upon the American side of the line causes an advance in price sufficient to make up for the high import duty. At present the greater portion of the alfalfa and barley is used in fattening cattle which are exported (1913).

Other cereals which are cultivated on a much smaller scale are corn for local consumption and wheat which, because of the absence of flour mills, must be exported to the American side. Cotton is becoming of considerable importance, since the yield is large; and although it must be sent across the border to be ginned, nevertheless the profits are very good, and some considerable portion has been exported directly to Japan. The farmers of the Imperial Valley in the United States are giving special attention at present to the raising of cotton, which within the last two or three years has been raised to such an extent that it has become the principal product of the region. The yield here is remarkable and the quality of the fiber is also superior when the kind and seed have been well chosen.

The products of this section suitable for stock-feeding are abundant, varied, and of good quality. Considerable areas are covered with grass or with "tule," and the berries of the mesquite and of the tornillo are excellent for fattening cattle. The area appropriate for stock-raising was estimated in 1907 at 170,000 hectares. It

should be noted that the cattle can be pastured only for nine months in the year in the part which is inundated. During the rest of the year the cattle could be maintained upon the desert portion, once this has been conquered and improved. The "tule" areas are fresh and green when other pastures are dry and furnish excellent feed for the stock during the dry season.

In the immediate vicinity of Mexicali, stock-raising depends upon tame pastures and forage crops, chiefly alfalfa and barley. Farther south, natural pastures are utilized principally. Large companies own the greater part of the animals and have introduced improved breeds, which appear to suffer little from the extreme heat. There is a considerable development of sheep-raising both for wool and for mutton.

b)[1] With the exception of a small and as yet undeveloped mining industry devoted to the mining of silver-lead ores and copper concentrates, the business of the Mexicali consular district is agricultural. Except in the high mountains, too rugged for cultivation but used for pasturage, there is a deficiency of rainfall that makes irrigation essential for the production of crops, though on the immediate coast the small rainfall aided by the mists and fogs from the sea makes possible the "dry farming" of wheat and beans.

The commercially productive part of the district is the irrigated section of the Colorado Delta about Mexicali. This productive area extends from California into Lower California and is known as the Imperial Valley, one of the largest and most recent irrigation projects in the world. Twenty years ago this land was a desert, and its extensive and intensive development is a matter of the last ten years.

Water is taken from the Colorado River just within the confines of the United States and led, because of favorable terrain, through Mexico, again entering the United States near Mexicali, which is exactly opposite and physically a part of the American city of Calexico, California. Under the joint arrangement 50 per cent of the water is to go to Mexico. The cost of the upkeep of the main canals and protective levées in Mexico is borne by the irrigation district

[1] Adapted from W. F. Boyle, *Supplement to Commerce Reports*, June 21, 1920, pp. 11–13.

in the United States, the said district owning the stock of the Mexican Water Company operating in Mexico.

The population of the consular district does not exceed 25,000 persons, the number living elsewhere than in the Mexicali irrigated area being negligible. This population includes some 5,000 Chinese, and several hundred Japanese. The Asiatic population is increasing, and the Chinese are reckoned as the most wealthy and commercially influential element.

Americans have large interests here, both in lands and in business, and they may be said to finance the entire business of the district. However, the actual conduct of the ranches as operators is gradually passing into the hands of the Chinese, with the Japanese entering the field now in increasing numbers.

Owing to the proximity to the United States, it is possible for any persons not excluded under American laws to reside in the United States while conducting business in Mexico; consequently practically all the ranchers, except the Chinese, reside in Calexico, California, maintain offices there, and make it the purchasing and shipping point of their supplies, equipment, etc.

Goods kept in stock on the Mexican side of the line would carry with them a large overhead expense in the shape of Mexican import duties paid at the time of importation, whereas goods kept in stock on the American side of the line are equally as available to purchasers and need only pay duty when introduced into Mexico for actual consumption. The result of this condition is to confine most business to the American side of the line, the one or two commercial houses of any import in Mexico being in the main distributing houses for their own ranches.

The one great crop of the district is cotton. Much of the land now under cultivation will soon become exhausted as regards further cotton production, without rest or rotation of crops, but it is difficult to find persons to undertake the cultivation of other crops. The cotton-growers feel that because of their number and the importance of the industry they can secure money more readily for financing their operations. In addition to this, cotton enters the United States free of duty, whereas early vegetables, melons, fruits, etc., for which the lands are adapted, in addition to the Mexican export duties, would encounter an American import duty.

3. THE STATES OF SINALOA AND NAYARIT (SONORAN DESERT)[1]

The American consular district of Mazatlan, Mexico, comprises the states of Sinaloa and Nayarit, the latter having been until recently the Territory of Tepic. In position on the west coast, these states correspond to the area between the mouth of the Rio Grande and Veracruz on the east coast. Culiacan is the capital of the state of Sinaloa, and Tepic is the capital of the state of Nayarit, but these towns and all others in this district, except Mazatlan, are simply agricultural and mining centers of little commercial importance.

Mazatlan, however, is a commercial center, and is the largest city in the district, its population being about 21,000. Mazatlan has always been a port of call for ocean vessels engaged in trade between west Mexico and the United States and Central and South America. For many years prior to the outbreak of the world-war, a number of tramp steamers and sailing vessels brought mining machinery, farming implements, and a great variety of hardware, tableware, notions, dry goods, etc., direct to Mazatlan from European countries, and carried back full loads of dyewoods, hides, textile fiber, ores, and a few other raw commodities.

Mazatlan is geographically well situated for a commercial, shipping, and industrial center. For ships plying down this coast between the United States and Mexican and Central American ports it is convenient of access on both the southward and the northward journeys, and the cargo landed here is distributed by smaller vessels up the Gulf of Lower California to San José del Cabo, La Paz, Santa Rosalia, Guaymas, Topolobampo, and Altata, and to the south to San Blas, Nayarit, and Las Penas, Jalisco. Much of the cargo is also carried to numerous interior points by rail both north and south of Mazatlan.

From the Sierra Madre several rivers flow westward to the Pacific Ocean, spreading out upon broad, rich valleys, which extend over the long level stretch from the foothills to the sea. Each of these valleys is an agricultural section somewhat peculiar to itself.

Fuerte River Valley. In the Fuerte River Valley in the northern part of Sinaloa, there is located an American colony and an agricultural

[1] Adapted from W. E. Chapman, *Supplement to Commerce Reports*, October 17, 1918, pp. 6–18, and October 30, 1919, pp. 6–15.

corporation with a large sugar factory operating on the property. A well-laid-out and well-maintained irrigation system provides all the water needed for this property, which extends for about 25 miles along the south bank of the Fuerte River, and is the center of the agricultural district in this region.

The presence of this colony, which uses modern machinery for its agricultural operations, has undoubtedly gone far toward educating the Mexican ranchers in modern methods of agriculture and thus contributed largely to the prosperity of the region and the increased sale of American agricultural implements.

The principal products of this district are, in the order of their importance, sugar cane, corn, tomatoes—nearly all of which are shipped to the United States—alfalfa, rice, garbanzo (chick pea), and vegetables. Comparatively large quantities of cantaloupes were formerly raised for shipment to the United States, but this production was stopped during the disturbances from 1911 to 1916, with their consequent interruptions of traffic, and has never been resumed.

The valley of the Fuerte River is better provided with means of transporting crops than most places in Mexico. The port of Topolobampo is located near the mouth of the river and provides a completely landlocked harbor for vessels of shallow draft. The Kansas City, Mexico & Orient Railway parallels the river between Topolobampo and El Fuerte, crossing the main line of the Pacific Railroad of Mexico at San Blas, the last-mentioned line affording direct transportation to the United States markets through Nogales, Arizona.

The northern portion of this consular district, embracing that part of the state of Sinaloa lying north of Mazatlan, has entered upon an era of prosperity never known heretofore, even in the days when peace and absolute personal guaranties were the rule. The development of the garbanzo- and tomato-growing industries, which have done more to bring about a better knowledge of agricultural and commercial usages as practiced in the United States than anything else, have been an important factor in bringing about this condition. The ready acceptance of American money at the conventional exchange rate—two for one—in the extreme northern part of the state has provided a medium of exchange which is lacking in the southern part of this district, and indeed in the major part of the Republic; and the abundant crops of corn, which have been more than sufficient

for local consumption and have permitted the exportation of large quantities to points in the interior of the Republic, at prices never heard of heretofore, have left in the hands of the ranchers, large and small, more actual cash than they have ever been able to get possession of before (1918).

There are two corn crops planted annually in this district. One is planted in January for harvest in May and June, and one in July for harvest in November and December. The early crops can only be grown on river-bottom land, where there is enough dampness for the corn to grow without rain. Large quantities of this crop were shipped by water from Mazatlan to Manzanillo and thence by rail to Mexico City (1919). Some shipments were also made north by rail in bond over the Southern Pacific Railway from Nogales, Arizona, to El Paso, Texas, and thence south into the state of Chihuahua, Mexico. Corn thus shipped sold for many times what it cost here, so that dealers realized large profits. The later crop was not shipped to other points, as corn is produced in many parts of Mexico in the latter part of the year.

The main garbanzo section of this consular district embraces an area extending from Guamuchil, on the Mocorito River in northern Sinaloa, to the Sinaloa-Sonora state line. A normal yield of this product in that section is from 100,000 to 150,000 sacks of 100 kilos (1 kilo = 2.2 pounds) each, the greater portion of which is exported through Nogales to New York and New Orleans in bond, from which points shipment is made chiefly to Cuba, Spain, and Porto Rico. This consular district is the largest sugar-producing section in Mexico, making about 40 per cent of the entire sugar output of the Mexican Republic.

Many other crops are produced for local consumption, such as beans, onions, Irish and sweet potatoes, beets, lettuce, melons, chili peppers, and peanuts, but no statistics concerning these are available. In general, these crops are not abundant for local markets in their respective seasons, and as a result they sell at exorbitant prices.

There are a good many varieties of tropical fruits produced locally, and as a general rule the supply is sufficient to meet the local demands, none being exported. Among these the mango, banana, alligator pear, lemon, orange, and coconut are the most popular. There

are several other smaller tropical fruits which are sought after by the natives. The bananas growing in the immediate vicinity of Mazatlan are of poor quality, but good bananas are shipped here in sufficient quantities from the state of Nayarit on the small boats which ply between Mazatlan and the port of San Blas.

There is scarcely a river in this consular district that does not offer from one to several favorable sites for the construction of reservoirs for the conservation of water, not only for irrigation, but for power and other purposes. There are several instances in which water could be utilized for power and the same water turned through large fertile fields for the irrigation of crops. One river near Mazatlan offers excellent opportunity in this direction.

Stock-Raising. The kinds of live stock raised in these states are, in the order of their importance, hogs, cattle, mules, horses, and goats. Sheep are almost unknown.

No attempt is made to raise hogs on a large scale, but every ranch, large and small, has its herd of hogs, which are either killed for home consumption or are sold to local butchers. The greater part of the meat is wasted, as the curing of the meat is next to impossible in this climate.

Cattle are not fed before being killed for the market, but are taken direct from the range. Even the feeding of milch cows is a rarity. The consequence is that the cattle are generally small in size and are not fat when killed, as they are on the verge of starvation for at least two months in the dry season. The same may be said of milch cows, which, for lack of milk-producing fodder, usually give little milk. Very few of the native ranchers have ever taken any interest in the improvement of their stock by breeding or by furnishing them sufficient food to allow of their full development. The importation of blooded cattle from the United States or Europe is very expensive business and entails considerable risk, as the sudden change of climate is very hard on the animals and extreme care must be exercised to prevent their contracting fatal diseases after arrival, even if they do not die en route.

As in the case of cattle, horse- and mule-raising is not conducted in a systematic or scientific manner. Bands of mares are allowed to run free on the range, and the colts are caught and broken as needed. Goats are raised in small numbers. They are required principally for

their milk and hides, and as their raising entails no expense whatever, are more or less community property in the small hill ranches.

Both Sinaloa and Nayarit are rich in gold and silver, and copper and lead are also found in commercial quantities in some of the gold and silver mines. However, where the mining companies have the facilities for reducing gold and silver to bullion form, they do not give much attention to saving the small quantities of other metals found. Ore is produced by a number of small mines scattered about in many places over the state of Sinaloa and in a few places in the northern part of the state of Nayarit, where mines are worked.

Mining companies do not carry stocks of their products on hand, except what is accumulated between shipments. It is their purpose always to ship as fast as they acquire possession of quantities sufficiently large to warrant the expense. By this procedure they have at all times credits in the banks in the United States.

The matter of transportation is always an important factor in connection with mining in this district. While the Southern Pacific Railway of Mexico runs parallel to the sea coast, from Nogales, Arizona, to as far south as the mines are operated, most of the mines are located some distance from the railway, out in the hills and mountains, so that Mexican mules and burros have to be used in carrying supplies from railway stations to the mines, and the mining products back on the return trip. In some cases, the distance is so great and the trail so rough that it takes three or four days to cover the trip one way. Formerly this line extended through to the city of Tepic, the capital of the state of Nayarit, but during the revolution of a few years ago the section of the road between Acaponeta and Tepic was so badly destroyed that all operations were suspended.

4. GEOGRAPHIC CONDITIONS AFFECTING LAND TENURE AND REVOLUTIONS IN MEXICO (NORTHERN BASINS)[1]

Without peering behind the veil of Mexican history, we need only glance at the modern country to realize how faithfully social conditions reflect local geography. The form of land tenure prevailing in Mexico, for instance, is due to the country's aridity. It

[1] Adapted from Leon Dominion, "Glimpses of the Mexican's Geographical Background," *Bulletin of the Geographical Society of Philadelphia*, XIV (1916), 84–88.

has been claimed that some seven thousand families out of a population of fifteen million inhabitants own the entire landed surface of the nation. In perhaps no other country of the world has land been parceled among such a small proportion of its sons. In the state of San Luis Potosi (area, 24,000 sq. mi.) the bulk of the land is in the hands of about 150 families. The proportion owned by members of this privileged minority often attains acreages of considerable magnitude. In the state of Chihuahua the area occupied by the Terrazas estate exceeds that of the states of Massachusetts and Rhode Island combined. Haciendas that lay effective claim to 1,000,000 acres are not infrequent in the other territorial divisions of the Republic. The term "hacienda" itself, meaning a plantation, has eventually become a measure of area corresponding to about 21,700 acres. This was the largest unit in use prior to the adoption of the metric system.

This restriction of landownership is attributable to the physical conditions prevailing over a great portion of Mexican soil. With the exception of the narrow coastal fringe, the slopes encircling the Plateau and the land extending south and east of the Isthmus of Tehuantepec, the entire surface of Mexico belongs to the type of elevated steppe characterized by scarcity of water. This feature becomes more pronounced with northerly distance from latitude 20°N. until beyond latitude 25°N. Mexican territory forms a vast desert area which extends from the shores of the Pacific Ocean to the Gulf Coast. Rainfall throughout this region seldom attains a mean annual of 20 inches. It often does not exceed 4 or 5 inches in some of its parts.

It is precisely within this desert zone that large plantations are found.[1] Conditions of aridity in Mexico prevail especially in the states of San Luis Potosi (north and west areas), Zacatecas, Durango, Coahuila, and Chihuahua. These states also contain the largest haciendas. In central and southern Mexico, however, where the soil receives a greater degree of moisture, the large properties of the northern districts give place to smaller lots of 5,000 or 6,000 acres and less, which are owned either by single individuals or constitute the joint property of the inhabitants of pueblos or Indian villages.

[1] The estate of the Zuloaga family west of the city of Chihuahua may be cited as an example. It is stated to cover 2,000,000 acres.

Even in a state like that of San Luis Potosi, where, as has been stated above, land is held by a relatively small number of families, ownership of the soil in the hot, humid districts tends to become normal and to revert to the majority of the inhabitants. This is well exemplified by conditions in the Huasteca district in the eastern part of the state.

In the main, the geographical fact of the increase in size of estates with growing aridity may be established for Mexico. This relation is natural, if not inevitable, since it has been determined by the impossibility of settlement beyond the radius of convenient distance from sources of water supply. The spring or well and its limited range of irrigation was the nucleus around which settlement centered and outside of which land was practically devoid of value. The incorporation of vast tracts to the original watered patch was a mere instance of absorption to which no opposition was worth offering. It provided the wide roaming space required for cattle wherever water is scarce.

In contrast to the extensive haciendas of arid Mexico the humid region around Cordoba, in the first stage of the Mexican temperate zone, is noted for its numerous subdivisions of property. Here the number of ranchos[1] and the percentage of landowners in the population exceeds that of any other area of equal size in Mexico. The district bears the reputation of being the most prosperous in the country.

Neither is the rôle to be assigned to the factor of aridity in Mexico's recent history devoid of importance. The revolutions which have disturbed Mexico's internal peace since 1910 have generally progressed from the northern states toward the capital. Their inception and progress has been marked with greater vehemence in arid Mexico, to wit: in the states of Chihuahua, Coahuila, Durango, Sonora, and San Luis Potosi. The other states have rallied to the cause which opposed the government established in the capital only when subjected to the pressure of armed bands gathered from the arid states. These facts suggest comparison with conditions prevailing in the other arid regions of the world, Arabia for instance. The causes determining tribal strifes among Arabs have their counterpart in the

[1] The term applied to small estates in contradistinction with "hacienda," the use of which is restricted to large plantations.

operation of natural processes which led to the Mexican civil struggles. Insecurity of life and property in Mexico, as in Arabia, increases with the degree of aridity.

5. THE MEXICAN CATTLE RANGES (NORTHERN BASINS)[1]

Mexico has as yet developed the production of cattle only to a small extent, and her significance as a factor in cattle-raising lies in her latent possibilities. The following is quoted from Frank J. Hagenbarth, of Utah, who developed the great Palomas ranch in Chihuahua.[2]

The greater part of the area of Mexico is above the tick line and all the plateaus leading to the Sierra Madre mountains are ideal for cattle-breeding purposes. Only the river bottoms and the coast country produce the bane of the cattle industry, the tick. The whole country grows Para grass in profusion. It is a marvelous feed, equal to the bunch grass of Montana. succulent and highly nutritious. The states of Sonora, Coahuila, Durango, Sinaloa, and Chihuahua not only produce this feed in great quantities, but boast of an excellent climate. Calves may come at any season of the year and encounter no vicissitude. It must not be presumed that no handicap exists, however. The northwest range country has a severe winter, while Mexico's greatest obstacle to cattle-raising is drouth. But this can be obviated by constructing dams and storing water that falls during the rainy season. The present practice, even on such properties as the Terrazas ranches, is to let cattle wander anywhere from ten to fifteen miles for water, if they find it then. I have met few people in Mexico who had even grasped the beef-raising possibilities of the country. A few Polled Durham and Hereford bulls have been taken in, but little effective effort can be detected, and any impression that northern Mexico is in a position to flood the United States markets with cattle of any kind is erroneous.

Packers report that cattle purchased in Mexico compare well with the northern United States range cattle that reach the Chicago market. However, Mexico has not yet realized the possibilities for the production of either cattle or sheep, and there can be no great immediate improvement. At least ten years will be required to restore the damage done by the insurrection.

[1] Taken from H. W. Mumford and L. D. Hall, "A Review of Beef Production in the United States," *University of Illinois, Agricultural Experiment Station, Circular No. 169*, pp. 23–24.

[2] *Breeders' Gazette*, June 21, 1911, p. 1453.

That Mexico is a growing factor affecting our own range-cattle industry is shown by the number of cattle brought across the Mexican line into the United States during recent years. For example, the number of cattle imported from Mexico in 1905 was 22,000; in 1906, 24,000; in 1907, 27,000; in 1908, 64,000; in 1909, 126,000; in 1910, 188,000. These cattle are grazed on ranges throughout the West. They have been taken as far north as Montana and even Canada, but are held principally in the Southwest until marketable as killers or feeders.

6. THE STATE OF COAHUILA (NORTHERN BASINS)[1]

The state of Coahuila is considered one of the most important in Mexico. Not only is it the third state in point of area, but also the coal fields of the Sabinas district, the fertile Laguna district around Torreon, famous for its cotton, its wheat production, and many other agricultural and mineral resources make it one of the wealthiest states, with a high educational average.

The Sabinas Coal Field. This field ranks first in Mexico in the production of bituminous coal; in fact, it is the source of supply for the whole Republic for railroad and smelting purposes. In the last years of the revolution the coal mines were greatly handicapped on account of confiscation, labor troubles, and the closing of the many smelters throughout the country which consumed their outputs; but the year 1918 saw the opening of many of the mines that had been closed down and a boom in the operation of those that had been running at half-capacity. The Mexican government has restored practically all of the mines to their former owners and the present state government is doing its utmost to favor mines in the handling of labor questions.

The output of the coal mines in this district is estimated to have reached 73,500 tons of coal a month in 1918. The normal rate of production of coal in Mexico is about 900,000 tons a year, but in recent years only about half of that quantity has been produced.

The Laguna Cotton District. The Laguna district, of which Torreon is the commercial center, has long been noted for its cotton

[1] Adapted from *Supplements to Commerce Reports*, April 28, 1919, pp. 10–13; October 30, 1919, pp. 21–22; and June 21, 1920, pp. 18–22.

production. The average normal crop is about 100,000 bales, but the crop of 1918 exceeded the average by about 35,000 bales. (Accurate statistics are not obtainable.) Under normal conditions the entire cotton crop is consumed by the Mexican mills, but of the 1918 crop probably 40 per cent will be exported.

The Laguna Valley, in the southwestern part of the state of Coahuila, is a dry basin about 100 miles square, which has often been compared to the Nile Delta. The soil is an alluvial deposit, washed down by the waters of two rivers which have their source in the adjoining state of Durango, and which for eight to nine months of the year are dry in this vicinity. During the short rainy season the rivers rise to a flood, and the water is diverted over portions of the land by canals and irrigation ditches, carrying with it the rich soil of the watershed and serving the double purpose of irrigation and fertilization. Under the present system of irrigation the available water supply is only sufficient for the cultivation of a small percentage of the land area. The average rainfall in the district of the Laguna is only about 8 inches annually. Where there is water for irrigation nearly all crops produce abundantly in the rich soil of the district, the principal agricultural products aside from cotton being corn, wheat, alfalfa, and beans.

The manufacture of soap, glycerin, and cottonseed products is a leading industry of the district. The largest factory in the Republic engaged in the manufacture of these products operates in Gomez Palacio, Durango, and several plants of minor importance, principally devoted to cottonseed oil and cake, are located in Torreon and other centers of the Laguna district.

The Saltillo District. Coahuila is the third state in Mexico in point of wheat production. Tributary to Saltillo there are from 600,000 to 800,000 acres of cultivable wheat land. Not more than 150,000 acres are usually sown and the crop depends largely upon the rains and snows for irrigation. The crop varies from 1,000,000 to 2,000,000 bushels per year, according to rainfall. January and February rains are necessary for a good crop, the wheat being sown in November and harvested in May, June, and July. The 1919 crop was approximately 2,000,000 bushels. The 1920 crop suffered for want of rain, and wheat was imported from the United States to supply the four local mills.

The ixtle industry is one of the foremost in the district. It is expected that the production of ixtle will increase as commercial conditions improve. The cost of production is far less than was expected, from the fact that low-grade labor is employed, and in many cases farmers and their tenants beat out the fiber during the days when they are not tilling the land. It is then sold in small amounts to the various ixtle-buyers, usually the leading merchants of the town, and in this manner is collected in carload lots for export, with slight expense.

Only two classes of ixtle are produced in this district in quantity. Lechuguilla ixtle (sometimes called tula ixtle) is derived from a plant of the agave family. It grows wild, no attempt being made to cultivate it. Only the new shoot, which springs up yearly in the center of the plant, is gathered. This is boiled, then shredded and combed out by hand, no machines having yet been devised which do not spoil the fiber. It is used for the manufacture of mats, sacks brushes, and to some extent for cordage. Before the war the greater part of the lechuguilla ixtle was shipped to Germany.

Palma ixtle comes from a plant of the yucca family, being a sort of desert palm with a tuft of spiked leaves. Like the lechuguilla ixtle, it is not cultivated and the fiber shoots are gathered and treated in the same manner. This fiber is of finer texture than the lechuguilla and is more used for cordage, a mixture of half palma ixtle and half henequen being common.

The ixtle industry in this district gives employment to about 15,000 workers, the peon wage being one peso per day. There is an ixtle factory at Monterey, but the local product is exported, as there is no factory here.

Ixtle is now the export second in importance to copper. It is perhaps significant that, coincident with the rise of the guayule industry from 1905 to 1912, the ixtle exportation steadily decreased, while in 1919 the ixtle exportation reached almost that of 1905 and the guayule figures were low. Quantitative figures and comparative prices are not available, but it is none the less certain that the ixtle production is steadily increasing and that the oriental supplies of para rubber have so undermined the guayule market as to make its production here almost profitless. The two Saltillo factories for the extraction of guayule gum are being dismantled and the machinery sold.

Saltillo is the center of an important mining district. The Mazapil Copper Company, an English corporation with main offices in Saltillo, has a three-furnace lead smelter on the outskirts of the city. This smelter has a capacity of 300 tons of ore per day. In 1920, it had a monthly output of about 720 tons of lead-silver bullion. This is shipped to England via Tampico. The same company has a larger smelter for handling copper ore at Concepcion del Oro, in northeastern Zacatecas. In addition there are a number of other copper and lead mines within the district. Copper matte made up practically two-thirds of the value of the exports from the Saltillo consular district to the United States in 1919.

Saltillo is important as a railroad center. It has two direct connections with the United States, one via Eagle Pass, Texas, the other via Monterey to Laredo, Texas.

7. A MEXICAN HACIENDA (NORTHERN BASINS)[1]

Extending southeastward from the Rio Grande, between high sierras on the east and west, is the Mexican Plateau. About 250 miles in width, this area extends from Juarez to its southern extremity, about 1,000 miles. Throughout an arid land, it lies under a clear sky and has few streams and little rain.

Its extensive plains are traversed at intervals by more or less isolated mountain ranges, mostly trending in parallel course with the Sierra Madre, which form its eastern and western walls. The mountains rise from 8,000 to 10,000 feet, but in the interior of the country they appear much lower, owing to the elevation of the plain itself, which increases in altitude from about 3,700 feet at Juarez to over 8,000 feet near the City of Mexico. The topography of this region is very similar to much of that of Arizona, New Mexico, and western Texas.

Though seemingly desolate, the land abounds in life, and the representatives of its fauna and flora occupy places in widely differing families of animals and plants. The country supports, however, a meager and scattered population, which, outside the cities, is con-

[1] Adapted from J. E. Kirkwood, "A Mexican Hacienda," *National Geographic Magazine*, May, 1914, pp. 563–84. Mr. Kirkwood is professor of botany in the University of Montana.

cerned chiefly with mining and stock-raising. While physically capable of a larger development agriculturally, this has not been possible under the system of land tenure which now obtains and has existed in Mexico from the early times of the Spanish occupation. The creation of enormous private estates, devoted to mining or grazing, and the domination of large sections of the country by the interests of a single individual or family have greatly hindered the growth of agricultural industry.

Feudal and Aristocratic. The Mexican estate known as a hacienda is in some respects a remarkable institution. Feudal in its traditions and aristocratic in its management, it reminds one of the old-world baronies of the Middle Ages. Consistent with political conditions in a country little more than nominally democratic, it is nevertheless so at variance with American ideals of liberty and equality that not the least of the interest in the system lies in the fact that such medievalism has flourished at our own doors up to the present time.

The story of the haciendas is one of romantic interest. Each, largely a law unto itself, developed its own institutions, had its life and activities apart from the rest of the state, and to all intents and purposes constituted a distinct social and economic unit.

The writer, not long ago, enjoyed the opportunity of a year's sojourn upon one of these haciendas. This estate, the Hacienda of the Cedars, is 70 miles long by 60 wide, a domain about equal in area to the state of Connecticut. Although much smaller than some of the other haciendas, it nevertheless constitutes a considerable property, being 2,500,000 acres in extent. From center to circumference is a day's journey or more, and the proprietor, when he visits the outlying portions of his estate, prepares for a journey of days or weeks with coach-and-six and attendants and much of the air of a petty ruler.

The Hacienda de Cedros lies in the northwestern corner of the state of Zacatecas. Mr. Charles T. Andrews, writing of life on a Mexican hacienda, says of this place:

There are several traditions in regard to the early history of the Cedros hacienda. One is that the original grantee obtained the land as a sort of subsidy for a missionary propaganda for "the conversion of the Indians and the glory of the church." There still remains indeed in the archives of Mexico a map of the hacienda with a sketch of the church building he

proposed to erect. According to these plans, the sacred edifice would cover about five acres. The result was like some modern schemes for public aid to private enterprise. The promoter got 2½ million acres of land and the church got a building 40 by 60 feet.

The Mexican Central Railroad crosses a corner of this estate at some distance south of Torreon. The station of Camacho, a sun-scorched and wind-swept row of adobe structures, is upon the hacienda, and eastward, over a distant range of mountains, lies the village of Cedros, the capital of this principality. Some 60 miles intervene, however, and to visit it one must proceed thither by horseback or wagon.

Many small assemblages of huts or houses are scattered over the place and are the homes of small ranchers or herdsmen. In all, about 2,000 people live upon the Hacienda de Cedros. These are distributed about in small groups here and there, where springs may be found or wells dug, or where the configuration of the land makes possible the gathering of the rainfall into reservoirs.

Water is precious, and its relative abundance determines the size of the village and often the nature of its operations. Issuing from the limestone at the western end of the Potreros are a number of fine springs, some warm and others cold, providing for irrigation of the gardens, for the baths, and for household uses. Some supply the long stone troughs where the herds come to drink. About these springs has grown up the little town of Cedros, and the cottonwoods have grown with it, until across the country their spreading tops are visible afar and almost obscure the white walls of the buildings they overshadow. It is a rare oasis in a wide desert, and shade here beckons the grateful traveler to its restful shelter.

Here all roads lead to Cedros. Tenuous threads of white, cutting the dull green of the distant plain, can be seen converging to this point like the spokes of a wheel. The site, well chosen for strategic reasons, commands its approaches on three sides, while the rough slopes of the mountain lie to the rear. Precautions against Indians and others were necessary in the early days, and parapet and loophole are still visible in the construction of the larger buildings. Though such occasions are less to be expected now, the place is still well adapted to withstand a siege of small arms. The defenses here have

somewhat fallen to decay; but at outlying stations some are yet well preserved, as where Canada Blanca, with wall and battlement, furnishes a place of refuge in the grazing country two days' journey to the west.

The village of Cedros consists of the *casa grande*, or manor house, with its associated structures, and the church, the dwellings of the peons, a ropewalk, an old smelter and ore mills, and corrals. Aside from the casa grande and its grounds, the village does not cover more than the space of three or four city blocks.

Homes of the Peons. The homes of peons are either huddled in groups or scattered about the outskirts, and, though mostly permanent structures built of adobe, they are arranged in no definite order, but are set up wherever chance or the convenience of the builder dictated. Many of the dwellings have small adjoining inclosures formed by a paling constructed of the wandlike branches of the candlewood, serving for garden lots or corrals.

Cheer and comfort are scarcely known to the peons' habitations. They are usually without the luxury of windows, the door serving to admit all the light that enters. The poorer huts have merely a hole in the wall as a means of entrance and exit; sometimes a room adjoining has no exterior opening, but is reached by a hole in the partition.

In these hovels some live, begrimed and hungry, in hopeless poverty. Others of the dwellings are much better. Such may boast some coarse matting and rude, home-made furniture and decorations of colored picture cards and tinsel. In these the dwellers have some regard for cleanliness and a measure of self-respect.

The Manor House. Across the open plaza stands the casa grande. This relic of manorial pretensions of more prosperous days, with the buildings adjoining and appertaining to it, rambles over several acres of ground. Its front elevation, like that of many other mansions of the land, is innocent of any suggestion of artistic effort, and rises a plain, whitewashed wall, broken only by the deep-set and securely grated windows and the heavy doors. It rises 30 feet to the parapet, providing two stories in the main building, though its adjoining structures have but one. Before recent improvements substituted a stronger wall for the old parapet, loopholes were still visible here

and there. The doors of the main entrance, like those of the church, are ponderously built of hewn timbers, and, being barred, offer effectual resistance to any seeking entrance by force.

Notwithstanding the prejudice which might naturally arise against sun-dried brick as a desirable or durable building material, they have been immensely useful in many forms of construction over a large part of the North American continent. They came extensively into service, probably, through the force of necessity where other materials were scarce or difficult to work, but they have abundantly demonstrated their usefulness. It would be difficult to imagine houses better adapted to the hot, dry climate of the Plateau than the adobe, properly constructed, which, when well finished, is clean and may be even beautiful in design.

The village of Cedros holds about 500 souls and the casa grande is the center of its life. The "large house" has always been the center of hacienda life. The establishment of the old haciendas, upon the lines of a feudal barony, was doubtless agreeable to the owners; but there were then, and also until recent years, conditions throughout the country which not only justified such a scheme of social organization, but made it a practical necessity. Unsettled and lawless as the land then was, infested by Indians and marauding bands of thieves, possession of the land was not only nine points in favor of the contestant, but the whole of the argument. It then behooved the proprietor of an estate to fortify himself and to secure his property against all who would wrest it from him.

To such, therefore, as he could offer protection and employment he came to be in the nature of a master, and such as enjoyed his favor and protection became identified with the property and attached to it as vassals. The law prohibiting a peon's leaving an estate while in debt to it practically made him a fixture, and this law, being still in force, makes his condition today little different from that of former times, though peonage has nominally been abolished.

The Peon. The peon is not ambitious; he is apathetic. But he has known no better life, and the lack of incentive to effort renders his mental and moral elevation a matter of greater difficulty than it otherwise might be. Taking into account the generations of servitude to which he has been subject, it is not strange that he

evinces no regard for the morrow, except as a time to which all disagreeable things should be postponed, and no concern for any interests other than those of the immediate present.

He is essentially a child and is to be treated as such. His salvation is not in higher wages, which would soon be squandered, leaving him in worse condition than before, but first in education of the right sort, which will give him an outlook upon life and an incentive to effort. At the time when the writer knew Cedros it had just passed from the control of its Mexican owners into the hands of an American company, whose interest in the property was mainly in the exploitation of guayule, a small rubber-bearing tree of the desert. With the advent of the new management an effort was made to improve the condition of the peon and the quality of his service by the payment of higher wages, with the result that he worked less than he did before and no more often than was necessary to eke out a subsistence.

Mixture of Spanish and Indian blood is common among the peon population. Many of these people are clean, intelligent, and industrious, but the reverse is more frequently true.

Industries of the Haciendas. It is hardly necessary to say that the operations of an hacienda in their character and extent are controlled very largely by the natural resources of the region occupied. Mining, farming, and stock-raising are the principal enterprises of the haciendas on the Plateau, while exploitation of native plants yielding fiber, rubber, liquors, etc., are also operations of importance in many places.

In most instances where the management of such business is in the hands of the Mexican and has not passed under the control of more progressive people, the methods employed are of the crudest sort. One observing their farming in the outlying districts might imagine himself living in the days of the Pharaohs. The field is plowed with a crooked stick drawn by oxen, with the yoke tied to the horns. Grain is cut with sickle and threshed by the hoofs of cattle, and corn is planted and shelled by hand. Rough and heavy home-made carts or the backs of men or burros are the most common modes of conveyance. The people seem to have no appreciation of improved farming implements. Often when improved implements are provided the laborers, they discard them for more primitive methods.

The principal agricultural crop of the region is corn, but small grains, beans, squashes, and a few vegetables are raised. Corn is the staple cereal for the poorer classes, furnishing material for tortillas and tamales; beans, chilis, and onions are easily grown and form some of the chief elements of the Mexican's diet.

All of these crops are matured in the short season of the summer rains. July and August can usually be depended upon for heavy showers at no distant intervals, and the drainage of the uncultivated ground is so managed that the run-off is directed over the fields, which thus receive not only the rain which falls upon them, but also that which falls upon a considerable area of the adjacent land. Plowing and seeding are done mostly in July, and October is the month of harvest.

The fruits produced in this region from the few trees growing in the better-watered situations are the fig, pomegranate, avocado, grape, quince, and some inferior apples. One of the most common of the fruits of the country is the tuna, the fruits of the cactus of the prickly-pear kind, which grows to immense size and is a feature of almost every well-ordered garden and dooryard. There are a number of varieties of this fruit, most of them being larger than a hen's egg and purple, red, or yellow in color. It is largely a food of the poorer class of people, who use it fresh or preserved. Pecans are largely planted for their nuts and for the ample shade which their crowns afford.

Stock-Raising. On the haciendas of the Plateau the business of stock-raising is one of the most important and one to which the natural features of the country are best adapted. Though semidesert in its character and with few springs and fewer streams, yet large herds of animals are raised on these vast plains.

At the time of the transfer of Cedros to its American owners it was estimated that the hacienda supported a half-million head of live stock of various kinds. So scant is the growtb of grass in this land, however, that one is not impressed with it at sight as a stock range, but the stock get much of their forage from leaves and twigs of many species of woody plants in which the place abounds.

The problem of water supply is a serious one and is solved by the construction of numerous *represas*, or *tanques*, in which the drainage of the surrounding slopes is collected in the rainy season. These tanks

are often many acres in extent and the water fills the shallow basin to the depth of 15 or 20 feet. A tank is formed by throwing a dam of earth or masonry across a valley at a convenient point, thus forming a reservoir into which are gathered the waters drained from a considerable area. In this way the herdsman makes good the lack of streams, for there is usually water retained in these tanks throughout the dry season. If the tanks are located in the vicinity of steep drainage areas, they are likely to become silted up in a few years, thus necessitating an increase in the height of the dam or the selection of another site for a new one.

Mining Properties. Many of the haciendas are mining properties of great value. Copper, silver, and lead are the most abundant products. The mountains of the region are richly mineralized, and here and there on a high crest may be seen the outward evidence of the more or less extensive operations going on within the mountain. Some of these mines were worked by the early Spaniards and are still productive. On the Naranjera property, at San Pedro Ocampo, the hill is honeycombed with pits and galleries from which in the early days ore was taken without science or system, except as the richness of the rock indicated the most profitable direction for the expenditure of effort. The work is now carried on under modern methods.

Fiber Plants. But Cedros is no longer a mining hacienda. Other interests have superseded, and in late years the Campania Ganadera y Textil de Cedros represented stock and fiber as its chief sources of revenue. Fiber-bearing plants are one of the natural resources of the country, and the amount of fiber shipped from this hacienda alone amounts to over 90 tons annually.

Two kinds of fiber are produced in large quantities. One is from the leaves of a yucca-like tree commonly called by the natives *palma*, and the other goes usually by the name *lechuguilla*, and is derived from a small relative of the century plant, exceedingly abundant throughout the northern half of the Republic. The fiber is soft, pliable, and strong and is much used for cordage, matting, bags, etc. Some of the fiber is manufactured locally, but most of it finds a market in New York and other foreign ports.

The articles made from these fibers are strong, firm, and compact, though somewhat coarse and rough. They are such articles as one

sees everywhere in Mexico—articles very well adapted to the purpose for which they are intended. A kind of heavy matting, much used for floor covering in offices and similar places, serves its purpose well. Besides these articles, the fiber is used in the manufacture of various kinds of cordage, and much of it finds its way into brushes, of which a great variety may be found both of home and of foreign manufacture.

Guayules. There grows extensively over the tableland a small desert tree, less than four feet in height, with silvery, grayish leaves. It grows often as the dominant plant over considerable areas of the calcareous foothills, where it gives an aspect to the vegetation similar to that of the sagebrush areas of our western plains. This plant is widely known as the *guayule*, and its product, a kind of rubber, has been an item of large commercial interest in central Mexico during the last decade.

Although it was known long ago that the plant produced rubber, its profitable extraction has been a matter of only recent years, and now on many of the haciendas the cutting of guayule is a thriving and remunerative business. The plant is generally uprooted, regardless of conservation principles, bound into bales, and shipped to factories in the cities. About 10 per cent of the dry weight of the tree is gum, which is separated from the tissue by grinding and extraction by solvents or by mechanical agencies.

Various other activities of greater or less magnitude and importance are features of the hacienda life, much as they have been since the first settlement of the country. Where the railroads have penetrated and foreign capital has entered, they feel to some extent the influence of the world's progress, and the march of events. At the best, however, they are isolated and provincial, living in the distant past, preferring old customs, manners, and dress, and tenacious of indolent habits, the rich and the poor alike.

The days of the old haciendas are numbered. Such institutions cannot long resist the pressure of the times. Capital is insistent for opportunity where there is profitable investment. Colonization enterprises in different parts of the country have already secured large areas and divided them into small tracts. Revolutions can only temporarily delay such development.

8. THE CORN CROP OF MEXICO[1]

The corn acreage of Mexico ranks next to that of the United States and is even more concentrated than in the United States, over 60 per cent being found in four states—Jalisco (42 per cent), Guanajuato, Mexico, and Yucatan (passing from left to right of map on opposite page). The principal centers of production are located in the southern section of the country, mostly on the High Plateau and in Yucatan. On the Plateau the summers are warm, but frosts occur occasionally in the winter months. Poor agricultural methods result in a low yield. Mexico has a greater proportion of cultivated land in this crop, however, than any other country, the acreage of corn about equaling that of all other crops. Most of the corn is grown in small patches of a few acres leased by the peons from the large landholders, and is produced by very primitive methods. A considerable proportion of the crop is grown under irrigation. The corn is used mostly for corn bread (*tortillas*), which, together with beans (*frijoles*), constitutes the staple diet of the Mexican people. Very little corn is exported from Mexico, and ordinarily over one million bushels are imported annually from the United States.

9. MEXICO AS A SOURCE OF HIDES AND SKINS[2]

The consensus of opinion as to the present number of cattle, calves, sheep, and goats in Mexico places it at about 25 per cent of the stocks which existed in 1910. Since that time those sections of the country which were formerly the greatest producers have been the scenes of almost constant turmoil. Not only were great numbers of cattle slaughtered by the revolutionists for hides and meat, but also by the owners themselves, in an effort to save them from depredations. The number of cattle, therefore, decreased constantly from 1910 to 1918, when conditions became somewhat more normal throughout the Republic. If conditions at the Mexico City *rastro* (slaughterhouse) are an indication of those prevailing throughout the country, the decrease in cattle killed daily since the years 1915 and 1916 would probably total 50 per cent, the decrease in

[1] Taken from V. C. Finch and O. E. Baker, *Geography of the World's Agriculture*, United States Department of Agriculture, Office of Farm Management, 1917, pp. 30, 34.

[2] Adapted from E. F. Feely, *Commerce Reports*, October 31, 1919, pp. 633–35.

Map 11.—Production of Corn (Maize) in Mexico

Each dot represents 100,000 bushels

calves 100 per cent, in sheep from 50 to 75 per cent, and in goats 75 per cent. Scarcity of all kinds of live stock, as well as lack of transportation facilities, are apparently the reasons for this great decrease.

The Mexico City rastro "take-off" is considered in the New York market as good, especially the Mexico City "packer hides," as they are called. During the past six months the demand from local tanners has been very heavy at the Mexico City rastro and elsewhere, and at present they are taking more than 75 per cent of the local production. Most of the exporters doing business in Mexico have their own hide cellars, with offices and employees under the direction of Americans. All hides purchased by exporters at the Mexico City slaughterhouse are salted by experienced men, just as it is done in the United States. Apparently only one American tanner is buying the raw or cured stock in Mexico City, all the other buyers being hide-exporters with connections in the United States.

The best hides in Mexico come from the Huasteca and the west-coast country. However, stock-raising has been almost abandoned in those regions since the owners have found it difficult to ship cattle to market. In certain sections of the country where there are well-defined seasons the hides vary accordingly, but in the upland sections of Mexico, on the Plateau, the hides are about the same all the year around.

Mexico's future position as a source of hides and skins depends almost entirely upon a return to conditions of stability. Certainly natural conditions are ideal for stock-raising in Mexico. There are vast stretches of unused grazing land, plenty of good water, and a splendid climate for this industry.

10. COTTON TEXTILE INDUSTRY OF MEXICO (CENTRAL PLATEAU AND SIERRA MADRE ORIENTAL)[1]

The first cotton textile mills in Mexico were established shortly after the country attained its independence, and were from the beginning protected by a very high tariff. Little progress was made, however, in the years that followed, on account of the almost continuous state of revolutions and disturbances.

[1] Adapted from E. F. Feely, *Commerce Reports*, October 29, 1920, 473–75.

In 1843 there were in Mexico 57 cotton textile plants, operating 125,000 spindles and producing 700,000 pieces (25 m. long) of coarse cotton cloth, known as *manta*, and used almost entirely as clothing for the Indian population.

The capital invested in the industry is almost entirely French, Spanish, and British, with the French predominating. The largest company actively engaged in the industry at present is the Compania Industrial de Orizaba (French), with a capital of 15,000,000 pesos (about $7,500,000 United States currency), which owns and operates several large mills at Orizaba, in the state of Veracruz. Others are the Compania Industrial Veracruzana (Spanish), also at Orizaba, with a capital of 3,500,000 pesos, and the Compania Industrial de Atlixco, S.A. (Spanish), one of the largest plants in Mexico, with a capital of about 6,000,000 pesos.

The years of peace which the country enjoyed under the Diaz régime attracted foreign capital in great volume, and the textile industry grew rapidly, always favored by a protective tariff. The greatest growth took place between the years 1900 and 1910, the increase in raw material consumed amounting to 150 per cent and the increase in production to 200 per cent. These years made for great advances and improvements in plants, machinery, and power, and were almost free from labor troubles. The plants were equipped with modern machinery and the industry as a whole was in a flourishing condition.

Condition Prior to the War and During the Revolution. At the end of the fiscal year 1913 there were 144 factories using 32,821,205 kilos of raw cotton, turning out 13,210,034 pieces (25 m. long) of cotton sheeting, prints, percales, etc., and operating 750,000 spindles. There were in that year 27,000 looms and 51 printing machines in operation, giving employment to 32,600 operatives and showing a production valued at 54,000,903 pesos. It is probable that the industry has not since exceeded this production. Since the first revolution under Madera broke out in 1911, the unsettled conditions of the country have offered but little incentive to the owners of the mills to make further investments. During the turbulent times which followed many of the mills were abandoned for years at a time, their machinery carried off and destroyed by bandits, and production greatly reduced. Some semblance of order was restored with the accession of the Carranza government in 1914, and with

raw cotton in great demand as the result of the world-war, Mexican planters began again to produce. The acreage was considerably extended and a record production has been reached this year.

The effect of the war on the textile industry was marked. With a large supply of raw material available and with cotton piece goods at high prices, such mills as had not been molested again began operations, and in 1918 and 1919 Mexico was able to export a considerable quantity of its production of cotton piece goods. A great part of the excess was purchased by American exporters for re-export to Cuba and Central and South America, and consisted of drills, percales, calicoes, and sheeting. According to latest statistics available 111 cotton textile mills were in operation in Mexico at the close of 1919. There are no exact figures as to the value of the production of the mills. Estimates of the amount of raw cotton which the industry would consume this year (1920) ranged from 90,000 to 100,000 bales of 500 pounds each, so that it is likely that the value and the volume of the output will be greater than ever before.

In spite of the high protective tariff the imports of cotton textiles into Mexico have steadily increased. This is explained by the fact that the imports are in a great part made up of the finer weaves and finishes which Mexico is unable to produce on account of its lack of adequate machinery, skilled operatives, etc. Foreign manufacturers, however, are unable to compete with Mexican mills in the cheaper goods, and will be unable to do so while the present tariff is in effect.

For many years Mexico was obliged to import raw cotton from the United States, but the Laguna district is now furnishing an adequate supply and this year will have an excess for export of about 100,000 bales. There has been, however, much criticism on the part of buyers that the Laguna cotton is not well classified and has caused confusion. The Mexican fiber has a long staple and has given excellent results in Great Britain, where 30,000 bales were used in 1919. Owing to the presence of the pink bollworm it is not admitted into the United States.

Previous to the war German dyes were used almost entirely and large stocks were held by German importers when the United States entered the European conflict. During the last two years American dyes have been used almost exclusively, and in spite of adverse propaganda are giving results.

The equipment of the mills is in the main modern and consists of German, British, French, American, and Belgian machinery. The mills in Mexico are located near available power sites, and with the exception of the plants in the Federal District are still utilizing some water-power. The others are using hydroelectric power, which is supplied now by the Mexico Light and Power Company from its Necaxa plant at the principal centers, Puebla, Orizaba, and Mexico City.

The managers, foremen, dyers, weavers, etc., are Europeans, French and Spanish in the main, but some Germans and a few Mexicans are found in these positions. They are, as a rule, trained men, brought from the large mills in Spain, France, and Germany. The operatives are, of course, Mexican, mostly Indians, and they are about as efficient as their wages indicate. At a recent hearing before the board of conciliation in Mexico City it was stated that the average wage paid the operatives in Orizaba was 1.83 pesos, or about 92 cents United States currency, per day. Their capacity for production in comparison with workmen of this country may be gauged by a comparison of wages paid to each. The labor problem, however, has been a serious one to the industry and frequently prolonged strikes have served greatly to curtail production.[1]

11. THE PETROLEUM INDUSTRY IN MEXICO (NORTHERN GULF COASTAL PLAIN)[2]

Topography and Drainage about Tampico. The topography of the states of Tamaulipas and Veracruz, and of Texas and Louisiana to the north, is controlled by the Gulf Coastal Plain, which, in northern Veracruz, has an average width of about 60 miles. To the west along the east flank of the Sierra Madre Oriental, the sedimentaries of the

[1] Manufacturing in 1919 was carried on in the following lines: Mining and smelting, cotton, clothing, pottery, breweries, foundries, rebozos, rugs, zarapes, hats, basketry, cigars and cigarettes, sugar, flour, bagging, twine, soap, leather, shoes, paper, iron and steel works, electric light and power. While no manufacturing is carried on on a large scale in Mexico, except mining and smelting, it is well distributed throughout the country and gives employment to many people. Primitive methods are followed in many of the industries, especially in the making of rugs, zarapes, rebozos, pottery, and basketry, which in general are carried on in the homes of the workmen. (*Supplement to Commerce Reports*, June 21, 1920, p. 3.)

[2] Adapted from V. R. Garfias, "The Oil Region of Northeastern Mexico," *Economic Geology*, X, 195–224.

plain are folded and upturned, and disturbed locally by volcanic intrusions. The transitional topography between that of the rugged flanks of the Sierra and the lowlands of the coast is made up of a series of terraces and irregular hills and valleys, which represent at the surface the more or less severe folding and displacements of the underlying basement. In the northern part the plain is made up of marls and clays, which, owing to their nearly horizontal position and impervious nature, give rise to numerous lagoons and marshes, particularly near Tampico and for 30 miles inland, where the flooded district constitutes at times about one-half the total area.

A topographic feature of the greatest economic importance as a means of transportation along this coast, where good natural harbors are the exception, is the Tamiahua Lagoon. This body of shallow water, with a maximum width of 10 miles, skirts the coast for about 90 miles between Tampico and Tuxpan, and is separated from the Gulf of Mexico by a strip of land nowhere over 4 miles wide. The lagoon proper is connected with the Panuco River and Tampico on the north by an artificial canal about 20 miles in length, and with the Tuxpan River on the south by a similar passage. It is therefore possible to transport freight throughout the year from Tampico to points to the south, the accessibility of which would otherwise be very uncertain during the stormy season.

The rainfall of the Coastal Plain is heavy, although irregularly distributed throughout the year. A great quantity of it, however, is absorbed by the mantle of vegetation, and the run-off is comparatively light. The most important streams are the Tamesi and Panuco, the union of which forms the harbor of Tampico, and the La Laja, Tanconchin, and Tuxpan rivers. All of these rivers afford a perennial supply of water, but with the exception of that furnished by the La Laja and Tanconchin, the quality of the water is not of the best. During the rainy season the volume of water carried by the streams is sufficient to overcome the inflow of salt water from the estuaries, but at other times this salt water creeps upstream for many miles, necessitating that intakes for fresh water be located at a considerable distance from the outlets of the rivers. Considering the great thickness and impervious nature of the shales which make up the plain, there is little probability of encountering an underground water supply of practical value.

Discovery and Location of the Fields. In 1901, the first successful oil well in Mexico was drilled about 50 miles west of Tampico. In the same year, the Mexican government issued a law with the object of encouraging prospecting for oil, in which, among other franchises, the free export of products, free import of machinery (on one occasion), and exemption from some taxes for a period of ten years were granted to the operator.

Soon afterward the English engineering firm of S. Pearson and Son, Ltd., started operations in the Isthmus of Tehuantepec in the southern part of Mexico, and in 1906 extended their work to the Huasteca region south of Tampico. On May 12, 1906, this company entered into a contract with the Mexican government for the purpose of exploiting government lands in the states of Chiapas, Campeche, Tabasco, and Veracruz, in the southern district of the state of Tamaulipas, and in Valles County, in the state of San Luis Potosi.

It is estimated that up to December 31, 1912, there had been drilled in Mexico 252 wells of which 64 were producing. Five of these yielded more than 90 per cent of the total production for the year. The fields producing in that year were within 40 miles of Tampico or Tuxpan.

Transportation of Oil. In the same manner that lack of transportation facilities affects the early development of any new territory, so has the lack of adequate means of transporting the oil from the wells to market hindered the successful operation of entire districts. Two factors control the transportation of the Mexican oil from the wells to seaboard, (1) the quality of the oil, and (2) the distance of the field from the shipping centers, Tampico and Tuxpan.

The oil produced in the Ebano and Panuco districts is of such low gravity and high viscosity that it cannot be pumped through pipe lines economically. Therefore it must be shipped either by first removing the heavy constituents and shipping the resultant fuel oil in tank cars (as is done at Ebano), or by transporting the crude oil in barges, as is done in the Panuco district. As most of the oil produced at Ebano is used for asphalt and fuel by the Mexican railroads, its transportation to Tampico does not greatly affect its disposal. The Panuco product, on the other hand, is exported and has to be barged about 60 miles along the river to Tampico, where it is stored in tanks before delivery to the tank steamers. Owing to its

high viscosity, it is necessary to heat this oil before delivering to the barges and again before loading it on the tank steamers from the storage tanks at Tampico.

Ideal wharfing facilities are available at Tampico where tank steamers are loaded in record time alongside the companies' storage farms. The loading of tank steamers at Tuxpan is not so efficient as at Tampico, although remarkable results have been obtained by running lines on the sea bottom to about a mile off shore, where the tankers anchor and are loaded through flexible piping connected to the submerged lines.

Although the tank steamers of foreign companies operating in these fields transport Mexican oil to the United States and Europe, the two principal Mexican oil companies are equipped with substantial fleets.

Production of Oil. The annual production of petroleum in barrels of 42 gallons in Mexico since 1904 is shown by the following table:

1904	221,000	1912	16,558,000
1905	320,000	1913	25,902,000
1906	1,097,000	1914	21,188,000
1907	1,718,000	1915	32,911,000
1908	3,482,000	1916	39,817,000
1909	2,498,000	1917	55,293,000
1910	3,333,000	1918	63,828,000
1911	14,052,000	1919	87,359,000

Markets and Refineries.[1] All oil exported from Mexico goes by tank ships. During normal times most of the Mexican railroads are equipped for oil-burning and obtain their fuel from the Ebano field, or from the several refineries at Tampico or Minatitlan after it has been "topped." By far the greater proportion of all Mexican oil which is exported goes to United States ports, where it is "topped" and the residue is sold as fuel or for paving purposes. During 1914 shipments of Mexican oil were as follows:

[1] Remainder of this reading taken from L. G. Huntley, "The Mexican Oil Fields," *Bulletin of the American Institute of Mining Engineers*, September, 1915, pp. 2083, 2106–7.

Destination	Barrels (42 gal.)
United States	15,476,727
Mexican coastwise	4,510,061
South America	195,138
Continental Europe	365,205
United Kingdom	67,780
Panama	46,446
Cuba	20,000
Total clearances	20,674,357

Problems of Production. It is believed that Mexico is potentially the second greatest oil-producing country in the world today. The reasons for this belief are summarized below, as well as the causes which will tend to hold back for some time the realization of the possible maximum production:

1. A large number of widely separated areas have been tested and have developed uniformly large wells.

2. With the exception of a few initial wells, none of these areas has been fully developed by the drill. There is thus a considerable acreage undeveloped in already proven territory.

3. Numerous promising localities remain untested in the present fields.

4. Large districts yet untested, such as those north of Tampico and west and northwest of Otontepec, offer surface evidence of the same characteristics as the proven fields.

5. The production per well has been large, and the decline slow in most fields.

6. The underground accumulations in fractured zones are capable of yielding a much larger percentage of their petroleum content than is a sand body.

7. More efficient methods of production result from the usual control of each producing district by one large company.

If such districts were located in the United States, they would soon be drilled up to a production such that the price would break to a very low point; but in Mexico this maximum production will doubtless be reached much more slowly, because of: (1) internal political difficulties; (2) delay in opening up isolated districts by railroads and pipe lines; (3) the many large tracts of land in most

districts, the expense of handling which keeps out small operators, who would overdrill; (4) the high expense of operating, which keeps out a host of adventurers; (5) the lack of tankers for transportation; (6) the difficulty, by reason of expensive production and transportation, of competing in the United States market with Gulf Coast and California fuel oils; and (7) the present overproduction of high-grade oil in the United States, which will delay the adaptation to Mexican oils of the new processes for refining heavy oils. These economic conditions account for the fact that Mexico, from wells having a present daily capacity of from 330,000 to 500,000 barrels, is producing only 70,000 barrels a day, and that no active endeavors adequate to this discrepancy are now in progress for the liberation and conveyance to the sea-coast of the enormous amount of oil thus shut in.

12. THE PENINSULA OF YUCATAN (EASTERN TIERRA CALIENTE)[1]

The position of Yucatan with respect to the rest of the world is highly isolated. Toward the south and east it is bounded by dense tropical forests which even in our day are penetrated neither by railway nor road. They can be traversed only along Indian trails, winding and crooked, and often coming blindly to an end. Even these poor apologies for paths are impassable except with the help of a party of natives armed with big machetes for cutting the young trees and lianas, which grow with astounding rapidity. The inhabitants of the forests are limited to a few scattered bands of Indians in the lowest stages of civilization. Often the traveler may go for days without seeing a village or even a camp. On the north, east, and west, Yucatan is surrounded by water, but that does not make it accessible. The harbors on the east coast are said to be fairly good, but the country back of them is covered with dense forests like those on the south, and hence they are almost useless as means of getting at the important portions of the country. On the north the coast is bordered by an almost continuous line of sand bars and lagoons. Within the lagoons the water is quiet and small boats can sail easily, but unfortunately it is not possible to go any great distance without

[1] Adapted from Ellsworth Huntington, "The Peninsula of Yucatan," *Bulletin of the American Geographical Society*, XLIV, 1912, 801–22. Mr. Huntington is research associate in geography at Yale University.

meeting barriers which force the navigator to take to the open sea. There the waves raised by the prevailing trade winds blowing freshly from the northeast are so high as to make long voyages too dangerous to be commonly undertaken. As far as modern steamers are concerned conditions are no better. Like all newly uplifted coastal plains Yucatan is bordered by very shallow seas. The steamers of the Ward Line, the only one plying regularly to the country, are forced to anchor three miles or more from land, and to send their freight and passengers ashore in a tug which pitches most disquietingly even in comparatively good weather. In bad weather it is often impossible to make a landing. On the west coast, known as Campeche, conditions are somewhat better because of less exposure to the winds, but the difficulties due to shallow water are not much different. Altogether the peninsula of Yucatan is a decidedly inaccessible region. No great trade routes touch it, its near neighbors on every side are backward, and there is little in its geographical position or in its degree of accessibility to permit of the stimulation which comes by contact with people of other ideas and habits.

Physiographically, as has already been implied, the northern part of Yucatan is a coastal plain newly uplifted from the sea. For scores of miles the general aspect of the country is absolutely flat. Near the center, low hills rise to a height of 300 or 400 feet, and farther south the relief becomes greater. The most noticeable ridge, so far as the inhabited portions of the country are concerned, runs southwestward from a point about 30 miles inland from the northwestern corner of the peninsula. Its rounded hills are a prominent feature in the landscape as looked at from the plain to the east, but they are nowhere difficult to cross. Nevertheless they form a genuine barrier to civilization, largely because of their relation to water supply, rainfall, and vegetation.

Practically all of Yucatan is composed of soluble limestone. This has given rise to one of the most widely known features of the country, that is, its underground drainage and *cenotes* or caves. The topography is almost universally of the type known as "karst." The karst, however, is not of the kind most commonly known, for in Yucatan we have to deal with a level plain instead of with a region of considerable relief. Because of the flatness of the country and the porous nature of the soluble limestone such a thing as a river is

unknown. Not even a brook is found in the whole region, and naturally there are no valleys either. The only break in the flat monotony is afforded by innumerable little hillocks 5 to 15 feet high. They lie in no regular order, being merely the remnants which happen to have been left between depressions in which a little water gathers in the rainy season. The water stands in pools for a while, and by so doing tends to dissolve the hollows to a deeper level. Only rarely does the water of one hollow run over into another, and even then not in sufficient amounts to make real running streams. Such being the case, the drainage of the country is naturally confined to underground channels. Often the concealed waters dissolve large caves, whose tops sometimes have fallen in, exposing the water at a depth of anywhere from 20 to 100 feet, and thus giving rise to the cenotes. These broken-down caves are of great importance to the inhabitants, for, as has already been said, they are the only places where a permanent supply of water is obtainable naturally throughout the year. At the time of the coming of the Spaniards all the native inhabitants, the Maya Indians, are said to have been clustered around them. Having no iron tools, the primitive Mayas were unable to dig wells. Today wells can be dug almost everywhere with full assurance of striking an abundant and unfailing supply of water. The only difficulty is that in the hilly regions the wells have to be sunk to a depth of from 100 to 200 feet, and the labor involved is sufficient in many cases to prevent the inefficient people of the tropics from making the attempt. Where ground water lies at a depth of only 20 to 30 feet, as in most parts of the plain, wells are numerous. In many cases the water is raised by windmills which seem to rise like a forest when one looks from a distance at such a town as Merida, the capital. During recent years, when Yucatan has grown rich from the henequen or sisal fiber industry, pumps run by gasoline or steam have in many places appeared.

Climatically, as well as in other ways, Yucatan is relatively simple. It lies in the trade-wind belt from about 18° 10′ to 21° 30′ N. In winter the brisk winds from the ocean pass over the land without giving up much moisture. The sky is clear a large part of the time, and although some rain falls in every month the amount in the northern parts is insignificant. Farther south, however, where the hills begin to rise, the rainfall increases rapidly, and showers are

quite frequent even in the dry season. The temperature in winter is agreeable, being rarely extremely warm and never cold according to the ideas of people from the north. There is, however, considerable variety, especially when the so-called northers blow. These appear to be connected with the cyclonic storms of the United States. The winds blow violently from the north and reduce the temperature to the lowest points ever reached. The minimum, however, is rarely below 50° F., while the maximum, even in winter, is usually above 86° F. In summer, as might be expected in this latitude, the maximum temperature is scarcely higher than in winter, although the minimum does not fall so low. The zone of subtropical rains exerts its accustomed influence and gives rise to heavy tropical showers. How greatly the summer rainfall exceeds that of winter may be seen from the accompanying table which gives the average monthly rainfall for the fifteen years from 1896 to 1910 inclusive at Merida:

Month	Rainfall in Inches	Month	Rainfall in Inches
January	0.88	July	4.90
February	0.68	August	8.48
March	0.58	September	4.46
April	0.74	October	3.04
May	1.70	November	1.94
June	5.61	December	1.36
TOTAL			34.37

The seasonal variation of rainfall is no more striking than its variation from region to region. In the north the rainfall is slight, being at a minimum on the coast in the neighborhood of Progreso. Here in 1911, the only year for which statistics are at hand, the precipitation amounted to 13.5 inches. In the southeastern and southern part of the peninsula the rainfall is more than 50 inches during the year. The cause for the variation in rainfall is twofold. In the first place, the presence of hills in the south and southwest on the one hand, and the proximity of the east coast to the open Caribbean Sea with its moist east winds on the other, give those regions more rain than has the north coast and northern interior. In the second place, we are here near the edge of the area reached by the zone of subequatorial rains. Hence the amount of these rains increases rapidly toward the equator.

With such marked changes in the amount of rainfall from place to place, it is evident that the vegetation must vary greatly, and this in turn must profoundly affect the conditions of human life. In regions like Progreso, where the rainfall is only from 10 to 15 inches and is concentrated largely in the summer, the long dry period of winter prevents the growth of anything except small bushes 6 or 8 feet high. These, however, thrive in abundance, so that the country is well covered with vegetation and is everywhere bright green in summer. In the dry winter, however, the leaves fall off and the landscape would be quite like that of a thick bushy pasture in the United States were it not that in March or April some of the bushes bear brilliant red, yellow, or white flowers. As one goes inland from the north coast to regions of greater rainfall the size of the bushes gradually increases and small trees appear. Even at the southern limit of the jungle, however, at places like Tecax and Peto, the diminutive limestone hillocks or the larger hills of the range bordering the administrative province of Yucatan are covered with a low, scrubby growth. Some trees rise 30 or 40 feet, and many 20 feet. There is nothing, however, to suggest the deep, somber forest. Small growths not over 20 feet high and with stems only 3 or 4 inches in diameter predominate. The aspect is like that of a second growth of timber in the northern United States fifteen or twenty years after the cutting of the original forest. A few bushes and even an occasional tree of some special species may remain green throughout the year, but most become as bare as northern trees.

From the jungle to the forest the transition is rapid. A day's ride on horseback is sometimes sufficient to take one from a well-developed sample of one to an almost equally well-developed sample of the other. The forest is of the kind whose descriptions are so familiar. Many trees remain green throughout the year. The trunks rise to heights of 50 or 60 feet even on the borders of their province, and at the top the leaves form a canopy so that the ground is usually shady. Until 9 or 10 A.M. the rays of the sun, even in the drier months when a portion of the leaves have fallen, scarcely reach the ground. Even at high noon the sunlight straggles through only in small patches. Long, sinuous lianas, often queerly braided, hang down from the trees; epiphytes and various other parasitic growths add their strange greens and reds to the varied complex of

plants. Young palms grow up almost in a night, and block a trail which was passable a few days before. Wherever the death of old trees forms an opening, hundreds of seedlings begin a fierce race to reach the light and strangle their competitors. Everywhere the dominant note is intensely vigorous life, rapid growth, and quick decay, as befits the warm, moist air which rarely varies and never is so cold or dry as seriously to interfere with the development of the most sensitive types of plants.

The people of Yucatan consist of every gradation from pure Indians to pure Spaniards. The forests and the remoter villages are occupied by Indians of the Maya stock; the small towns and the less remote villages are peopled by a mixed race of mestizos in which the Indian element predominates, while in the larger towns and their environs the proportion of Spanish blood steadily rises. The degree of energy and initiative is almost directly in proportion to the amount of Spanish blood. The pure Indian is a quiet, slow being, inoffensive and retiring unless abused. He never seems to work unless compelled. As for storing up anything for the future, the thought seems never to enter his head. If he has enough to eat he simply sits still and enjoys life until hunger again arouses him to activity. His wants are few and easily supplied. His agriculture begins by cutting the smaller trees of the jungle, girdling the few larger ones, leaving the brush to dry during the season of little rain, and finally burning it off. Then, with a pointed stick he makes holes into which he drops corn, beans, and the seeds of the pumpkin, or of one or two other vegetables. The corn is his chief reliance. When the crop is ripe, he never thinks of gathering it all at once, or of storing it away safely, perhaps in the form of flour. His method is to go out to the field in the early part of the dry season after the corn is well ripe, and bend down each stalk so that the ears point downward and shed the occasional rains. Of course, he uses what corn he needs day by day, and his wife grinds a little each morning for the day's tortillas, but beyond this he attempts little. Week by week he picks what ears he needs, caring nothing that insects, birds, and beasts are eating what they need also. He knows that a quarter or a third of the ears may be spoiled, but so long as some are left, he cares little. The only thing that ultimately stirs him up to gather the remainder of the crop is the end of the dry season. Before the

rains come he knows that he must burn over his field and plant more seed or else he will starve. Therefore he arouses himself for a period of effort at least once during the year. He is hardly to be blamed for his apparent laziness. He certainly is lazy according to our standards, but he has little to stimulate him, and it is easy to get a living without much work. In good qualities, however, he is by no means lacking. He is extremely courteous, and according to all accounts he excels in both honesty and morality.

As the amount of Spanish blood in the people of Yucatan increases, their energy and resourcefulness also increase. They also become more light-hearted and gay than the silent, sober Indians, but at the same time the degree of honesty and morality is said to decrease markedly.

The human inhabitants of Yucatan are distributed unequally. Practically all of the 400,000 people of the peninsula live in the jungle region of Yucatan proper and the coastal strip north of Campeche, an area smaller than that of Massachusetts. The rest of the country, comprising most of the province of Campeche and the territory known as Quintana Roo, contains only a few wild Indians estimated at 4,000 or 5,000 in number. The reason is not far to seek: the tropical forest has hitherto proved unconquerable.

Today, in spite of the slowness and inefficiency of the inhabitants as compared with European races, the country compares most favorably with other tropical lands. Indeed, it is so wealthy that some travelers have supposed Merida to be the richest city in the world in proportion to its size. Whether this be true or not, there can be no doubt that the country is rich, and that signs of poverty are hard to find. Possibly this apparent prosperity is partly due to the excessive neatness of the people, for neatness is in most countries the luxury of the well-to-do. Perhaps, too, their neatness in itself is a help against poverty. However that may be, there is at the present time a distinct and special reason why Yucatan has an extraordinarily prosperous air and impresses the casual traveler as quite different from most tropical countries. This reason is the henequen or sisal fiber industry. Henequen, as is well known, is a species of agave which grows well in the relatively dry portions of Yucatan. The fiber is the strongest and most durable known, its only rival being Manila hemp. The growth of the demand for strong fibers,

occasioned especially by the expansion of the grain fields in America and elsewhere, has for many years tended to increase the value of henequen, and has led to the planting of many square miles of the yucca in long, monotonous rows extending across the hillocky plain between uncompromisingly angular stone walls. This, too, has led to the building of a large number of narrow-gauge railroads in the dry northern part of Yucatan, and to the construction of hundreds of miles of diminutive tram lines leading off from the railroad stations to the larger henequen *fincas*. At the time of the Spanish War in 1898 the supply of Manila hemp was cut off for a few years and the price of henequen began to soar. Now it has fallen a good deal, but the fiber is still a highly valuable export and makes the country much more prosperous than it could be without the aid of some such highly specialized product. The whole aspect of the country shows this, for it is the cause not only of the abundant railroads and tram lines, the almost imposing houses at some of the estates, and the fine dwellings of Merida, but also of the excellent public buildings and finely paved streets which make such an impression upon the traveler when he first arrives.

13. FOREST PRODUCTS OF THE HUMID TROPICAL LOWLANDS OF MEXICO (EASTERN TIERRA CALIENTE)[1]

In those regions of Mexico which enjoy a moist tropical climate, such as the southern part of the peninsula of Yucatan, and the southern slopes of the Sierra Madre of Chiapas, the forests are still very extensive, for only in the vicinity of the more densely populated regions have they been destroyed to any considerable extent. The inhabitants, both Indians and mestizos, have a custom of making large clearings and burning the trees and brush as soon as these are sufficiently dry. As a result, the neighboring forests frequently are set on fire, but because of the great humidity such fires do not extend to any great distance.

The importance of the forest industries is slight in comparison with the great extent of the forests, both because of the difficulty of

[1] Adapted by Alice Foster from Carlos Sapper, "Sobre la geografía física y la geología de la península de Yucatán," *Boletín del Instituto Geológico de México*, No. 3 (1896), pp. 38–40.

communication within the forests and because the utility of the products of these forests has not been thoroughly investigated. There is no doubt that further study of the woods, juices, gums, and resins of these forests would reveal other useful products. At present the only forest products exported are, (1) sarsaparilla root, which is found in nearly all the moist woods; (2) the chicle of the chico-zapote; (3) rubber from the castilla rubber tree; (4) dyes from the logwood and the mora; and (5) mahogany and cedar woods. The mahogany, cedar, logwood, mora, rubber, and chico-zapote are found only in places with uniformly high temperature, and up to the present time have not been found in the states of Yucatan, Campeche, Tabasco, and Chiapas at altitudes above 2,700 feet above sea-level. Cedar and mahogany are found only in the very moist woods, and since they will float in water, they may be cut in places distant from the sea. When the rivers are in flood the logs are thrown into the streams and floated to the sea. It is not possible to export the mahogany and cedar logs from localities (1) where there are no rivers, as in southern Yucatan, (2) where the rivers have high waterfalls, or (3) where a part of the course of a stream is subterranean, as in various of the northern and eastern parts of Chiapas. The principal ports for the exportation of these woods are Minatitlan and Laguna de Terminos.

Logwood is found in moist woods, especially in places which are periodically inundated, and also in less moist woods, as in the interior of the peninsula of Yucatan. It is exported principally from Minatitlan, Laguna de Terminos, Champoton, Campeche, and Belize. Mora wood is less important commercially. These woods will not float in water and therefore can be exploited only where they can be shipped by boats or rafts on the navigable streams, as in Tabasco; or over wagon roads, as in the northern part of Yucatan; or by tramways, as in the vicinity of Champoton. Where there is lack of transportation facilities, as in the interior of the peninsula of Yucatan, or in eastern Chiapas, above the rapids which interrupt the navigation of the Usumasinta near Tenosique, the woods cannot be exploited unless the extracts are derived at the place where the trees are cut.

The rubber tree is found only in the moist woods of the Tierra Caliente. The chico-zapote is found both in the moist woods and

in the drier woods which resemble the chaparral of the Tierra Caliente. In the export of the commercial products of these trees (respectively rubber and chicle) the condition of the roads and the distance from seaports are not such critical matters. Unfortunately the rubber-gatherers bleed the trees excessively, and thereby kill them. For this reason in Soconusco, on the Pacific slope of southern Chiapas, there are now almost no wild rubber trees, and the few rubber plantations which have been established in the district are not as yet producing quantities equal to the former export.

14. ANIMAL INDUSTRIES OF SOUTHERN MEXICO[1]

In all inhabited parts of Mexico hens and pigs are raised on a small scale, almost exclusively for domestic use. The major animal industry of the states of Yucatan, Campeche, Tabasco, and Chiapas in southern Mexico is the raising of horses, mules, and sheep, which form an important part of the national wealth. Stock-raising is carried on chiefly in the less humid sections, where there are natural pastures. In the humid regions the growth of the jungle is so rapid that good pastures can be obtained only with great difficulty and at great expense. For this reason it will be understood that the animal industries are most important in the savanna regions of these states. The raising of horses and mules is carried on in both the hot and temperate localities, the animals being exported in considerable numbers from Chiapas and Tabasco to Yucatan, and from Chiapas to the neighboring republic of Guatemala. Sheep-raising is carried on principally in the cold and rather dry parts of Chiapas, where the natives weave woolen fabrics on their very primitive looms. Although the production of wool is not small, there is no surplus for export. On the contrary, there is some slight import of woolen goods from foreign countries. In Comitan, woolen yarn is made which serves to decorate the long braids of the Indian women, and this yarn is exported to Guatemala.

[1] Adapted by Alice Foster from Carlos Sapper, "Sobre la geografía física y la geología de la península de Yucatán," *Boletín del Instituto Geológico de México*, No. 3 (1896), pp. 40–41.

15. THE RELATION OF GEOGRAPHIC CONDITIONS TO THE DEVELOPMENT OF THE MEXICAN RAILROAD SYSTEM[1]

The railroad history of Mexico began with the first presidential term of General Diaz. The program laid out at that time by the new government, and responded to by the nation, was to develop its natural elements of wealth; to repeople the national territory which foreign wars and internal strife had almost depopulated; to cross the land with ample and rapid ways of communication; to open new markets to Mexican products; to increase internal trade; to end at once and forever fiscal penury and its fatal, and until then inevitable, consequences; to re-establish the lost national credit; to diffuse popular instruction; and, finally, to promote in every way public and private prosperity, thus redeeming the nation from the double slavery of ignorance and poverty, and elevating it, through its wealth and power, to the high level that it ought to occupy among civilized nations.

To establish and insure peace, it was necessary to join the integral parts of the country by means of rapid ways of transit, a military strategical necessity. Moreover, beyond their military significance, such means of rapid and easy internal transportation, permitting freedom of travel, trade, and correspondence, would stimulate enterprise, increase production, and promote the growth of both general intelligence and national wealth.

The technical problem of Mexico's rapid and economical means of communication was not difficult. On the map, Mexico has the shape of a leg of mutton, wide at the north; its coast lines joining in curves to form at the south the Isthmus of Tehuantepec; without navigable rivers, except in the narrow and uncultivated mountainous and tropical regions of the south; and with two formidable systems of mountains parallel to the coasts, forming in the center of the country the great tableland of Mexico, inhabited by about half the total population. This tableland has the same general shape as the country, namely, an oblique triangle with its base upon the northern frontier of the Rio Grande and its apex about in the valley of the City of Mexico. South of this valley the two coast systems of mountains mix and join, so that the rest of the country down to the

[1] Adapted from Victor M. Braschi, "The Mexican Railroad-System," *Transactions of the American Institute of Mining Engineers*, XXXII (1902), 259–62.

Isthmus of Tehuantepec is mountainous, with the exception, of course, of the flat coast fringes. The central tableland is not absolutely level, but slopes northward to the Rio Grande, and is crossed by numerous separate systems of mountains and hills, independent of the two coast ranges.

The population of Mexico is distributed roughly as follows:

	Per Cent
Central states	47
Pacific Coast states	33
Gulf of Mexico states	12
Northern frontier	8
TOTAL	100

In 1877 the central tableland, containing about half the population, and which is the true and typical Mexico, was thus separated from the coast by two systems of mountain ranges, and its own principal subdivisions were separated by long distances, occupied by large, uncultivated, and almost desert territories. The north, with its long, thinly settled frontier and only 8 per cent of the total population, was indeed a free and wide field for insurrection and smuggling. The Pacific Coast states, with one-third of the population, were entirely separated from the rest of the country by the Sierra Madre Mountains. These physical barriers, of course, still remain; but statesmanship and enterprise have so far overcome them that they are no longer absolute barriers. It is as if they had been half obliterated.

Mexico, therefore, was then a nation composed of almost independent provinces or petty states, united only by a common language, origin, and history, and by memories of a common resistance to two foreign aggressions, notwithstanding which they tore each other up in internal fratricidal wars. These states, separated by difficult mountains and extensive deserts, had accentuated their natural isolation by raising against each other artificial walls in the shape of interior customhouses; and their highways were infested by bandits, encouraged by the long intervals between cities, and by repeated revolutionary disorders. When the modern history of Mexico began in 1877, the country was anxious and ready for a change.

The topographical and geographical distribution of the population being such as we have seen, and no navigable rivers existing in the populated portion of the country, the engineering scheme for rapid ways of transit proposed, of course, a net of railroads. This was composed, broadly speaking, of the following systems:

1. Lines which, starting from various points on the northern frontier upon the Rio Grande, should cross the great central tableland, converging at the capital, the apex of the triangle of the tableland. These lines would join the capital to the central and northern states, and, crossing vast uncultivated territories, would connect with the railroad systems of the United States.

2. Lines which, starting from the Gulf of Mexico, should climb the east or Gulf range of mountains, to join the central tableland with the Gulf.

3. Lines which, starting from the City of Mexico and its neighborhood, should invade the mountainous regions of the South and the Southern Pacific Coast.

4. Lines which, crossing the Sierra Madre from any possible point on the west, should join the Pacific Coast with the center and the Gulf.

5. Subsidiary lines and branches.

16. THE MEXICAN RAILWAYS[1]

During the period of comparative quiet which Mexico enjoyed between 1877, the beginning of President Diaz' régime, and 1911, the beginning of the revolutionary period, a marked economic advance was made. Perhaps the most notable result of this period is the present rather extensive railway system. In 1910, when President Diaz retired, Mexico had some 16,000 miles of railway track, including about 3,000 miles of narrow-gauge track (mostly unimportant local roads) and 8,200 miles of government-owned or -controlled track. As in most of the Latin American countries, the railroads of Mexico have been built each one for some special purpose, with little regard to any general plan. Consequently, in some parts of the country, two or more roads compete for traffic which is scarcely sufficient to support one, while rich mineral and agricultural sections remain

[1] Adapted from *Latin American Circular, No. 41* (1918) Bureau of Foreign and Domestic Commerce.

undeveloped because of their isolation. Acapulco, the best natural harbor of Mexico and the natural outlet for a rich section of the country, is little used because it lacks railroad connections with the interior.

In 1912, approximately $1,057,770,000 American capital was invested in Mexico, $321,302,800 English, and $143,466,000 French. Of this American capital $235,464,000 was invested in railway stocks and $408,926,000 in railway bonds; $81,237,800 English capital in railway stocks and $87,680,000 in railway bonds; $17,000,000 French capital in railway bonds; $125,440,000 Mexican capital in railway stocks and $12,275,000 in railway bonds; $75,000 from other countries in stocks and $38,535,380 in bonds.

Under the Diaz government, concessions granted to private companies for railroad construction provided for the automatic return of the roads to the government after a stated period, usually ninety years, upon the payment by the government of compensation for rolling stock, buildings, and materials on hand at the date of the transfer. In 1903, the government began to buy controlling interests in three of the most important railways of the country and in 1909 united these three lines under the name of the National Railways of Mexico. This company, in which the government owned 50.3 per cent of the stock, was gradually extended to include other roads, until it became by far the most important system of the country.

National Railways of Mexico. This company owns 6,818 miles of track and controls an additional 1,220 miles. The following roads are owned: The old National Railway, 803 miles in length, extends from Laredo on the northern border to Mexico City, traversing Nuevo Leon and San Luis Potosi, and is the only outlet for mining districts from which zinc and lead are now being exported to the United States. From Monterey, a branch extends to Matamoros on the border and a second branch west to Torreon. The Mexican Central extends from Ciudad Juarez on the border across the great central uplands to Mexico City and has numerous branches. One of these extends to Tampico and connects with the Laredo line at San Luis Potosi. A second branch extends to Manzanillo on the Pacific. The Mexican International Railway extends from Ciudad Porfirio Diaz south through the state of Coahuila and then east to Monterey and west to Durango. According to a recent report,

construction work has been resumed on the branch from Durango to Mazatlan, opening up a new timber region from which cross ties may be obtained. The Veracruz & Isthmus Railroad connects the part of Veracruz with the Tehuantepec Railway. The Pan-American Railway extends from a station on the Tehuantepec Railway along the Pacific Coastal Plain to a point on the Guatemalan border.

The Interoceanic and the Mexican Southern are owned by British interests, but are controlled by the government and form part of the National Railways system. The Interoceanic Railway runs from Veracruz to Mexico City. The Mexican Southern runs from the city of Puebla through the state of Oaxaca to the city of Oaxaca and some 60 miles farther to Ejutla.

Mexican Railway. This system has 520 miles of track, including the main line from Veracruz to Mexico City and several branch lines. With the exception of the short period between September 1, 1916, and March 31, 1917, the property of the company has been under the control of the Mexican government since November, 1914, and during this entire time only the most necessary repairs have been made. It is estimated that an outlay of £2,000,000 sterling will be necessary to restore the road to its former good condition when the company once more assumes control.

Tehuantepec Railway. This company owns the line (184 miles of track) which crosses the isthmus from Puerto Mexico on the Atlantic to Salina Cruz on the Pacific, and also completed port works on both coasts. Before the revolution, S. Pearson & Company, of London, the builders of the road and port works, and the Mexican government were partners in this company, each with an equal amount of capital invested.

For a few years after the building of the railroad there was a considerable amount of cargo shipped across the isthmus in transit from an Atlantic to a Pacific port of the United States, or vice versa. During the calendar year 1908 the cargo so transshipped amounted to 348,000 metric tons, and during 1911 to more than 1,000,000 tons. Most of this traffic was sugar from the Hawaiian Islands intended for Philadelphia and New York, and general merchandise going from the east coast of the United States to the west coast and to the Hawaiian Islands.

Due to the unsettled political conditions in this country in recent years, this transshipment traffic entirely stopped. Recently a few shipments of cabinet woods and of coffee have been made to the eastern coast of the United States from the west coast of Central America via this isthmus, but the traffic is so far insignificant. In an effort to encourage such traffic the Mexican government has made certain concessions in the payment of port charges to vessels engaged in such traffic. Whether or not the reductions already made will be efficacious in again building up such traffic remains to be seen.

Mexico Northwestern. This company is incorporated under the laws of Canada and controls various lumber mills and timber land in northern Mexico as well as 512 miles of track, 370 of which it owns. The Mexican Northwestern Railway runs from Ciudad Juarez to Chihuahua and is reported to have suffered more from the revolution than any other road in Mexico.

The Southern Pacific of Mexico. This road is owned by the Southern Pacific of the United States and has approximately 1,000 miles of track. The main line extends from Nogales, Arizona, southward through the state of Sonora and down the west coast to Tepic, from which point it is eventually to go to Guadalajara and Mexico City.

United Railways of Yucatan. The company has lines from Merida to Progreso and Campeche, and from Merida east and south through the state of Yucatan. There were 500 miles of railway operating (1918) in the consular district of Progreso, which included most of the peninsula of Yucatan, and the trackage was reported to be in good condition although it had had little care.

17. THE FOREIGN TRADE OF MEXICO[1]

TABLE XXXV

FOREIGN TRADE OF MEXICO BY PORTS

The ports of Veracruz and Tampico handle more than half of the foreign trade of the country, as shown by the following table, which shows the import and export trade by ports for 1912-13:

Ports	Imports	Exports
Gulf Ports:		
Coatzacoalcos (Puerto Mexico)	$ 2,520,000	$ 3,315,000
Frontera	740,000	1,476,000
Progreso	5,601,000	14,598,000
Tampico	22,825,000	40,379,000
Veracruz	40,733,000	42,118,000
Others	944,000	5,688,000
Pacific ports:		
Guaymas	1,115,000	1,461,000
Manzanillo	740,000	153,000
Mazatlan	1,252,000	2,123,000
Salina Cruz	311,000	670,000
Santa Rosalia	799,000	3,191,000
Others	764,000	1,150,000
Northern frontier ports:		
Agua Prieta	602,000	1,994,000
Ciudad Juarez	1,686,000	4,115,000
La Marita	3,016,000	9,931,000
Laredo	9,395,000	7,702,000
Matamoras	837,000	1,189,000
Nogales	925,000	5,135,000
Piedras Negras	2,186,000	2,168,000
Others	495,000	723,000
Southern frontier ports	9,000	321,000
TOTAL	$97,495,000	$149,602,000

[1] Adapted from *Commercial Relations of the United States, 1912*, Bureau of Foreign and Domestic Commerce (Washington, 1914), pp. 106–8.

TABLE XXXVI

VALUE OF PRINCIPAL IMPORTS INTO AND EXPORTS FROM MEXICO IN 1912–13

Imports	Value 1912–13	Exports	Value 1912–13
Animal substances:		Animal products:	
Animals, live	$ 598,006	Bones, horns, and hair	$ 163,154
Manufactures		Cattle	3,760,689
Footwear	1,830,665	Hides, untanned	5,562,876
Furs and leather	1,236,429	Others	392,521
Miscellaneous	299,125	Mineral products:	
Products and wastes	5,020,401	Antimony	784,599
Vegetable substances:		Asphalt	468,650
Fibers, textile	2,116,970	Copper	18,188,014
Fruits and grain	4,595,250	Gold	19,716,531
Manufactures, various	2,448,487	Lead	2,443,852
Wood	2,630,693	Silver	45,464,239
Other	3,930,233	Zinc	266,975
Mineral substances:		Others	7,112,148
Gold, silver, and platinum	736,259	Vegetable products:	
Copper and its alloys	3,120,660	Beans	577,861
Tin, lead, and zinc	848,595	Chick peas	2,455,320
Iron and steel	12,092,987	Chicle	2,162,252
Other metals	42,168	Coffee	5,609,323
Stones and earths	6,787,889	Fruit, fresh	507,312
Textiles:		Guayule	3,602,819
Cotton		Henequen	15,006,609
Yarn	1,461,444	Ixtle	1,888,754
Fabrics	4,324,442	Rubber	4,171,422
Manufactured articles	1,867,091	Tobacco	499,300
Wool		Vanilla	1,651,105
Yarn	74,906	Wood	1,675,835
Fabrics	1,525,001	Others	2,991,679
Manufactured articles	652,473	Manufactured products:	
Flax, hemp, and similar		Bran	101,422
fibers	613,699	Flour and meal	259,636
Silk	1,034,564	Hats	277,597
Silk mixtures	934,576	Sugar	428,570
Artificial silk	403,209	Tobacco	159,126
Chemical and pharmaceuti-		Others	439,590
cal products	6,283,279	Other products	812,217
Spritis, beverages, etc.	3,412,189		
Paper and paper products:		TOTAL	$149,601,997
Waste and pulp	506,852		
Paper and cardboard	425,135		
Paper manufactures	1,701,307		
Machinery and apparatus	12,200,344		
Vehicles	2,543,101		
Arms and explosives	3,853,309		
All other articles	5,342,887		
TOTAL	$97,494,625		

TABLE XXXVII

Total Value of Imports into and Exports from Mexico, by Principal Countries, in the Fiscal Years Ending June 30, 1912 and 1913

	Imports		Exports	
	1911–12	1912–13	1911–12	1912–13
United States	$49,020,000	$48,500,000	$111,600,000	$115,550,000
United Kingdom	10,710,000	12,900,000	20,020,000	15,500,000
Germany	11,880,000	12,560,000	5,140,000	8,190,000
France	7,780,000	9,130,000	4,150,000	3,560,000
Belgium	1,630,000	1,400,000	3,170,000	2,570,000
Spain	2,940,000	5,240,000	1,180,000	1,090,000
Total, including all others	$90,980,000	$97,490,000	$148,400,000	$149,600,000

18. POPULATION OF MEXICO IN 1910

TABLE XXXVIII

States and Territories	Population, 1910, per Square Mile	Total	States and Territories	Population, 1910, per Square Mile	Total
Aguascalientes	40.6	118,978	Nuevo Leon	15.4	368,929
Campeche	4.7	85,795	Oaxaco	29.3	1,041,035
Chiapas	16.1	436,817	Puebla	90.2	1,092,456
Chihuahua	4.6	405,265	Queretaro	68.8	243,515
Coahuila	5.7	367,652	Quintana Roo	0.4	9,086
Colima	34.2	77,704	San Luis Potosi	24.7	624,748
Durango	12.8	436,147	Sinaloa	9.6	323,499
Federal District	1556.8	719,052	Sonora	3.4	262,545
Guanajuato	95.1	1,075,270	Tobasco	18.6	183,708
Guerrero	20.1	605,437	Tamaulipas	7.7	249,253
Hidalgo	74.7	641,895	Tlaxcala	115.4	183,805
Jalisco	37.9	1,202,802	Vera Cruz	38.7	1,124,368
Lower California	0.8	52,244	Yucatan	9.6	337,020
Mexico	107.0	975,019	Zacatecas	19.2	475,863
Michoacan	43.3	991,649			
Morelos	60.4	179,814	Grand total	19.2	15,063,207
Nayarit	15.1	171,837			

CHAPTER XV

RESOURCES AND INDUSTRIES OF ALASKA

I. POPULATION OF ALASKA

TABLE XXXIX

DISTRIBUTION AND COMPOSITION OF THE POPULATION OF THE TERRITORY OF ALASKA BY JUDICIAL DISTRICTS IN 1920[1]

POPULATION	THE TERRITORY	JUDICIAL DISTRICT*			
		First	Second	Third	Fourth
Total population	55,036	17,402	10,890	16,231	10,513
Native white	16,286	7,291	928	4,983	3,084
Percentage native white	29.6	41.9	8.5	30.7	29.3
Foreign-born white	11,597	4,409	785	3,618	2,785
Percentage foreign-born white	21.1	25.3	7.2	22.3	26.5
Indian	26,558	5,357	9,158	7,453	4,590
Percentage Indian	48.3	30.8	84.1	45.9	43.7

* The first district includes southeastern Alaska, the second the three peninsulas of western Alaska, the third southern Alaska, including the Alaska Peninsula and the Aleutian Islands, and the fourth central and northeastern Alaska.

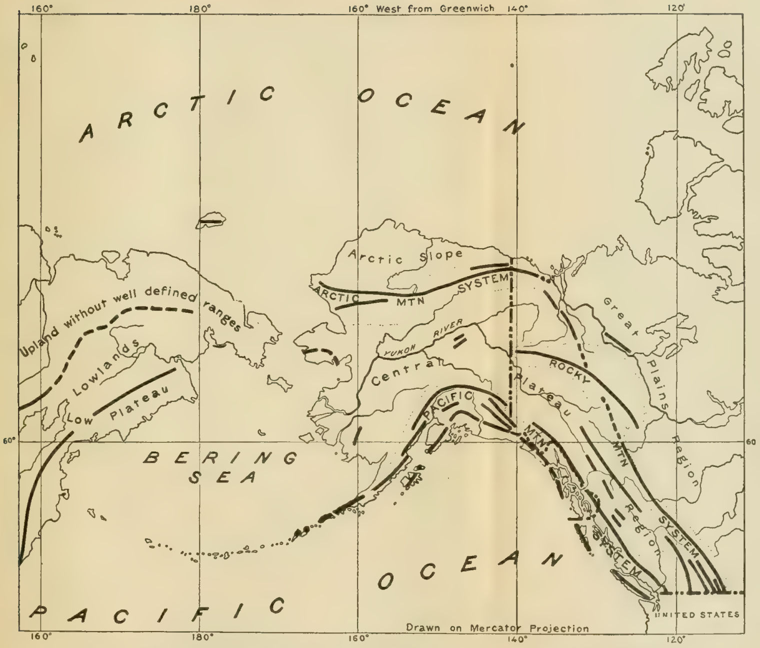
2. PHYSIOGRAPHIC PROVINCES OF ALASKA[2]

Five principal physiographic provinces, each divisible into sub-provinces, are recognizable in Alaska. These are (1) Pacific Mountain system, (2) Central Plateau region, (3) Rocky Mountain system, (4) Arctic Mountain system, and (5) Arctic Slope region.

The Pacific Mountain system is made up of a number of parallel ranges forming a rugged highland of crescentic outline sweeping around the Gulf of Alaska. Its central part is upward of two hundred miles in width, but the system narrows to the southeast and to the

[1] *Fourteenth Census of the United States*, 1920.

[2] Taken from Alfred H. Brooks, "The Physiographic Provinces of Alaska," *Journal of the Washington Academy of Sciences*, May 4, 1916, pp. 252–53. Mr. Brooks is geologist in charge of the division of Alaskan mineral resources, United States Geological Survey. [I am greatly indebted to Mr. Brooks for numerous extracts from his publications, for his previously unpublished map on the opposite page, and for numerous suggestions as to the selection of material for this chapter.—C. C. C.]



MAP 12.—GEOGRAPHIC PROVINCES OF NORTHWESTERN NORTH AMERICA AND NORTHEASTERN SIBERIA
Drawn by Alfred H. Brooks, United States Geological Survey, 1922, published here for the first time

southwest. It is continued to the southeast by the Coast Range of British Columbia and to the southwest by the rugged Aleutian Islands. Several subprovinces of lesser relief are included within the Pacific Mountain system. In most places the inland slope of this system falls off abruptly to the Central Plateau region, though the line of demarcation between the two provinces is not everywhere well defined.

The Central Plateau region is characterized by flat-topped inter-stream areas separated by broad valleys and lowlands and broken by minor ranges and peaks that rise above the general level. The plateau feature is best developed in the upper Yukon basin, for it loses its definition on approaching Bering Sea. Here the characteristic topography consists of low, rounded highlands rising island-like from broad lowlands.

The Rocky Mountain system maintains its northwesterly trend through western Canada to within about 400 miles of the Arctic Ocean and then bends to the west and enters Alaska as a single range (Ogilvie Mountains). Crossing the boundary just south of the 66th parallel it loses its definition and soon merges with the flat summits of the Central Plateau region. The Crazy and White mountains of the Yukon-Tanana region that stand above the plateau level lie in the continuation of the Rocky Mountain axis.

A new name, Arctic Mountain system, is proposed for the east and west trending mountain system of northern Alaska formerly regarded as part of the Rocky Mountain system. Recent investigations by Canadian and American geologists have shown that this is a distinct system from the Rocky Mountains, although they are connected by the flat-topped Richardson Mountains forming the Mackenzie-Porcupine divide. The Arctic Mountain system stretches westward from the International Boundary to the Arctic Ocean north of Kotzebue Sound. It is not everywhere sharply differentiated from the plateau region to the south, for in many places the dissected plateau remnants merge with the foothills of the ranges. In its western part the northern limit of the lowlands of the Kobuk Valley affords a definite line of demarcation. On the north the mountains, so far as known, everywhere fall off abruptly to the Arctic Slope. This scarp affords a definite boundary line between the two provinces. The system is made up throughout its extent of two or more parallel

ranges and includes some broad lowlands. These lowlands are specially striking topographic features in the western half of the chain. The Arctic Mountain system is continued east of the boundary by some mountains of lesser altitude. These end in a scarp at the Mackenzie delta, east of which they have not been recognized.

The Arctic Slope region has two subdivisions, the Anaktuvuk Plateau and the Coastal Plain. The first forms a piedmont plateau sloping northward from the base of the range. Along the Colville River it has a width of about 50 miles, but it narrows to the east. At the boundary it appears to be entirely absent, for here only a narrow coastal plain intervenes between the mountains and the sea. The westward extension of Anaktuvuk Plateau is unexplored. On the north the plateau is bounded by a scarp which separates it from the Coastal Plain. This plain varies from a width of less than 10 miles at the boundary to over 150 south of Point Barrow.

All of the features described, except those of the Arctic Slope region, form a part of the North American cordillera. Tectonically, however, the Arctic Mountain system is a discordant element in this cordillera. Its structures parallel the Arctic Ocean, and its folding was probably caused by movements from the Polar Sea. Tectonically and possibly physiographically it is to be correlated with the Werojanski Range and its northeastward extension of Siberia.

Drainage Basins.[1] The drainage of Alaska belongs to three divisions: Its southern part, about one-fifth of its area, drains to the Pacific Ocean; the great interior region, nearly one-half of all Alaska, drains into Bering Sea; and the rest of the territory, its northern part, drains to the Arctic Ocean.

The Yukon, flowing into Bering Sea, and the fifth river in size in North America, rises in British Columbia, far to the southeast of Alaska. The Kuskokwim, also emptying into Bering Sea, is second in size only to the Yukon among Alaska rivers. It rises on the western slope of the Alaska Range, and its course is southwesterly, generally parallel to the Yukon.

The Pacific drainage embraces two classes of rivers: First, those whose basins lie entirely within the coastal mountains, such as the Susitna and Copper; and second, those which rise in the interior

[1] Taken from *General Information Regarding the Territory of Alaska, Edition of September, 1918, Department of the Interior, Office of the Secretary*, p. 8.

and traverse the mountains on their way to the sea, such as the Alsek, Taku, and Stikine.

The Arctic Ocean receives waters from a small part of the plateau province through short rivers draining the northern part of the Seward Peninsula, from larger ones flowing into Kotzebue Sound, and from interior valleys and northern slopes of the Rocky Mountain ranges.

3. CLIMATIC PROVINCES OF ALASKA[1]

Though Alaska is often loosely referred to as an Arctic province, yet nearly three-quarters of its area lies within the North Temperate Zone. Geographic position and extent relative to oceanic bodies, together with relief, have brought about physical conditions producing strong contrasts in climate between different parts of the Territory. Three general climatic provinces, each of which in turn includes a number of subordinate provinces, are recognized.

The first is the maritime province lying adjacent to the Pacific Ocean. This has heavy precipitation (50 to 190 inches), comparatively high mean annual temperature (35° to 48° F.), cool summers (mean temperatures 50° to 55° F.), and mild winters (mean temperatures 20° to 35° F.). It has small variations of annual extremes of temperature compared with the interior provinces, the records showing from −27° to 94°. The second is the inland province lying beyond the coastal mountains, with a continental climate characterized by semiaridity (precipitation 9 to 15 inches), comparatively warm summers (mean temperatures 50° to 58 F.), and cold winters (mean temperatures 0° to −15° F.). Its most striking feature is the extreme annual variation in temperature, which is from −76° to 100° F. The mean annual temperature varies from 15° to 27° F. The third province includes the region tributary to the Arctic Ocean, which, according to a few records, has a precipitation of only about 6 to 8 inches, an average summer temperature of from 40° to 45° F., a winter temperature of about −10° to −16° F., and an extreme variation, according to a few records, of −54° to 66° F.

The climate of the Pacific coastal province is comparable with that of Scotland and the Scandinavian Peninsula, in Europe, but is

[1] Adapted from the report of the Alaska Railroad Commission: *House Doc.*, *1346*, *62d Cong.*, *3d sess.*, pp. 28–32; the figures have been revised by the Weather Bureau, Department of Agriculture.

somewhat warmer. That of the inland region is not unlike the climate of Alberta, Saskatchewan, and Manitoba, in Canada. The northerly province bordering the Polar Sea is the only one in which Arctic conditions prevail.

4. THE FUTURE OF ALASKA MINING[1]

As there are no political subdivisions of Alaska, it will be desirable to refer the distribution of its resources to the physiographic provinces, defined on Map 12, opposite page 412. The Pacific province includes the lode and placer districts of southeastern Alaska, the Controller Bay coal and petroleum fields, the copper lodes of Prince William Sound, the copper-bearing lodes and gold placers of the Copper River region, the gold placers and lodes and coal fields of the Susitna and Matanuska basins and of the Kenai Peninsula, and the coal fields and gold and copper lodes of the Alaska Peninsula and adjacent islands, often called southwestern Alaska. This whole coast province is a region of strong relief, and much of it is readily accessible from the waters of the Pacific, open to navigation throughout the year.

The mountain system included within the Pacific province forms a high barrier between the coast and the central province, which is of lesser relief. This central province, drained to Bering Sea by the Yukon, Kuskokwim, and some smaller rivers, includes the gold placers of the Yukon-Tanana region, the Koyukuk, and some smaller districts, as well as extensive deposits of lignitic coal. It is accessible in summer by river steamers, but in winter only by long sled journeys.

Seward Peninsula, forming a distinct province, embraces valuable gold placers, as well as some auriferous and argentiferous lodes, some tin deposits, and a little lignitic coal. It is accessible by steamer only during the summer months.

Northern Alaska is here made to include the high mountains which bound the central province on the north, as well as the region of lesser relief bordering the Arctic Ocean. This field has been but little explored, but it is known to contain some placer gold and bituminous as well as lignitic coal. It seems probable that further surveys will show the presence of extensive coal fields in northern Alaska.

[1] Adapted from Alfred H. Brooks, "The Future of Alaska Mining and the Alaskan Mining Industry in 1919," *United States Geological Survey, Bulletin 714–A*, pp. 5–57, and "Mineral Resources of Alaska," *Bulletin 394*, pp. 173–74.

These geographic subdivisions have an important influence on the question of the conservation of the mineral wealth of the Territory, for as the geographic conditions dominate the commercial exploitation of the resources, they determine in a large measure the rapidity with which these resources will become exhausted. For example, the lode deposits and coal fields readily accessible from the Pacific seaboard are being exploited for the use of the present generation. On the other hand, though the development of the placer fields of the central province began nearly a generation ago, large areas are still entirely unprospected, and the coal fields of the same region are almost entirely untouched. The coal fields of northern Alaska are not only entirely undeveloped, but are certain to remain so until the time in the future when the accessible coal of Alaska and the United States approaches exhaustion.

The Alaska mining industry, which has turned out products having a total value of $438,160,000, began in 1880 with the recovery of some $20,000 worth of gold from placers near Juneau. Of this total value 96 per cent is to be credited to the gold and copper deposits, but Alaska mines have also produced silver, platinum, palladium, tin, lead, antimony, tungsten, chromite, coal, petroleum, marble, gypsum, graphite, and barite, and development work had been done on deposits carrying nickel, iron, molybdenite, and sulphur.

The exploitation of Alaska's mineral wealth before the war showed a rather steady growth, with some fluctuations from year to year, such as are more or less inherent to mining in remote regions. This advance was made in spite of the handicaps imposed by isolation, the inadequacy of means of communication, and the long existing interdict on the development of the coal and oil fields. Then came the change of industrial conditions wrought by the war. Its first effect was to increase Alaska's output of copper enormously, owing to the high price of that metal, and this increase in 1916 brought the value of the total mineral output of Alaska up to over $48,632,000, a larger amount than that for any other year since mining began. The decline in price and market demand for copper since 1916 has greatly reduced Alaska's output of copper. Meanwhile the world-wide depression of the gold-mining industry has also greatly affected Alaska. As a consequence the value of the total mineral output of the Territory in 1919 was only $19,621,000, as compared with $28,254,000 in 1918, and was the lowest annual value since 1914.

Although many local factors affect the future of the Alaska mining industry, the most important consists of the mineral reserves. Unless the accessible reserves are large enough to support a future growth the mining industry, no matter how favorable may be the conditions of exploitation, will languish. Those who have inquired about the quantity of mineral reserves have usually received the stereotyped answer that Alaska has vast stores of mineral wealth awaiting development. However true this may be, the public has a right to know on what facts such statements are based. An attempt will be made here to summarize briefly these facts, which are scattered through scores of publications of the United States Geological Survey, and to forecast, so far as may be, the future of Alaska as a producer of minerals.

Gold Mining in the Past. During 40 years of mining Alaska has produced gold to the value of $311,665,000, of which $218,000,000 is to be credited to the placer mines. The first notable impetus given to gold mining in the Territory was the discovery of the Nome placers in 1898 and their rapid development, which reached its maximum in 1906. Meanwhile the placer gold from the Fairbanks district, first developed in 1903, helped to swell the gold output, into a maximum production in 1909. Much the larger part of the placer gold recovered in these two fields, as well as in most other placer districts, such as Iditarod, Hot Springs, and Koyukuk, has been taken from relatively small and very rich or so-called bonanza deposits rather than from larger bodies of gravel having a lower gold content. The production of placer gold in the past has therefore been maintained by the exploitation of new bonanzas rather than by larger installations in the developed districts. Since 1911, however, there has been a gradual improvement in mining methods, notably in the use of gold dredges, by which over $20,000,000 worth of gold has been recovered.

Auriferous lodes in Alaska have yielded $92,000,000 worth of gold, of which more than 80 per cent has come from the six large low-grade mines of the Juneau district. Successful lode mining at Juneau, in complete contrast to most of the placer operations, has been based on the exploitation of low-grade deposits on a very large scale. The mines have, indeed, been operated at a lower unit cost than any others in the world. The average value per ton of the gold

and silver recovered from the ore produced in these mines since 1882 is \$1.95. The small margin of profit was offset by the very large tonnage of ore handled. Because of the small margin these operations were naturally among the first to react to the economic conditions that have affected gold mining so adversely.

Most of the lode mines outside of the Juneau district have been small ventures that could practice none of the economies introduced at Juneau. Therefore, with the decline of mining at Juneau, Alaska's auriferous lode-mining industry has received a serious setback.

Gold Placers. Auriferous gravels are very widely distributed over Alaska, but it is only in comparatively small areas that their gold content is high enough to permit profitable exploitation or, in other words, to constitute a placer. The question whether a body of auriferous gravels is a placer depends on the cost of its exploitation. If it can be exploited at a profit it is a placer, no matter how small its gold content. At one locality a body of gravel carrying less than 25 cents worth of gold to the cubic yard may be a placer, whereas at another a body of gravel whose gold content has a value of several dollars to the cubic yard may be worthless. Some of the conditions that affect mining costs, such as physical character and thickness of the deposit, grade of streams, and availability of water, are fixed. Others, relating chiefly to accessibility, may be improved by betterment of means of communication. Thus a body of gravel whose gold content is too low for profitable exploitation at one time may, with improvements in transportation, become a valuable placer. In the early days of mining at Nome gravels that carried less than \$5 in gold to the cubic yard could not be profitably exploited, but in 1918 the 21 dredges operating on Seward Peninsula made an average gold recovery per cubic yard of only 40 cents. Again, the average value of gold in all the gravel mined in Alaska in 1911 was \$2.17 per cubic yard; in 1918 it was \$1.20. This change has been due to a cheapening of mining cost, both by larger installations and by better means of communication. These facts of themselves make it impossible to estimate closely the reserves of the Alaska placers, even if the quantity and gold contents of the auriferous gravels were known, for it is impossible now to forecast what part of these gravels will in the future prove to be workable placers. On the assumption, however, that profitable mining will be possible in the future on the same grade of

placers as it has in the past, a rough measure of the placer reserves can be arrived at.

A careful scrutiny of all the available geologic, statistical, and mining data indicates that the original total length of creek gravels that probably carry enough gold to be classed as placers is about 1,050 miles. Of this total, deposits aggregating about 200 miles are on creeks whose alluvial floors are 15 yards or less in width, and the rest on streams whose valley floors are chiefly from 50 to 100 yards wide, with some that have a width of 300 yards or more. In this total mileage have been included only those stream gravels which have been mined or more or less prospected. The many large deposits of gravels which are known to be auriferous, but about whose gold content no information is available, are not included in this estimate.

It is believed that of this 1,050 miles of original gold placer ground, 250 miles has been mined out. The value of the total placer-gold output of Alaska is $218,000,000, of which about $18,000,000 is to be credited to beach and high bench placers that are not included in this estimate of stream gravels. Therefore, as nearly as can be determined, the stream gravel placers thus far exploited have yielded gold to the value of $800,000 to the mile. Much of the placer gold has been won from bonanza deposits, such as those of Nome, Fairbanks, and Hot Springs. The Fairbanks placers have produced about $2,000,000 worth of gold to the mile for the ground actually mined, and the recovery from the creek placers of the Seward Peninsula has been about $500,000 to the mile. On the other hand, the recovery has been only $50,000 to the mile in some of the poorer districts.

Although it is quite possible that other very rich creek placers will be found in Alaska, notably in the Yukon and Kuskokwim basins, where there are many streams that have not yet been thoroughly prospected, yet a forecast of the future cannot take account of such possible discoveries, and must include in the estimate of available reserves only placers about whose gold content there is some information based on actual development. If the gold-placer reserves are measured by the least valuable creek placers that have thus far been developed, namely, at $50,000 a mile, the total value will be $40,000,000; if the estimate is based on the average gold recovery of the past, the total value will be $640,000,000. The truth will lie somewhere between these two extremes. In the writer's opinion it will

be conservative to estimate the value of the undeveloped creek placers at $200,000 a mile, a figure which will make the value of the total creek placer reserves $160,000,000. To these must be added the reserves of bench and ancient beach and gravel placers. Deposits of these types have been developed and tested only on Seward Peninsula. It was estimated some years ago that the value of the gold reserves in the gravel-plain, ancient-beach, and high-bench placers of Seward Peninsula was about $215,000,000. Subtracting the amount of gold that has since been mined from these deposits leaves the value of the reserve $200,000,000. This very large reserve compared with those of other parts of Alaska is due largely to the fact that in Seward Peninsula the cost of mining has been much lower than elsewhere in Alaska. Therefore deposits of a low gold tenor are included in the reserve.

In view of the above facts it is believed that the available placer-gold reserves in the developed districts of Alaska have a value of at least $360,000,000 and perhaps of twice that amount. There is also the possibilities of discoveries of new deposits, of which not even a rough estimate can be made.

Gold Lodes. Few of the Alaska gold-lode mines have blocked out ore to supply them for more than a few years in advance, and therefore there is no basis for estimating their reserves, which are developed from year to year. The large Juneau mines, where development work has usually been kept well in advance of the stoping, can for the present not be counted as a very definite source of gold. Most of the other auriferous lode mines are equipped with only small plants. Many of them are, indeed, only prospects with small mills, operated for only a part of the year. Were the future of Alaska's gold-lode mining dependent on the developed mines, the outlook would not be hopeful.

The wide distribution of gold placers is in itself an indication of widespread mineralization. Gold placers by no means give definite evidence that the gold is sufficiently concentrated in its bedrock source to be profitably mined. Yet the placers show that the bedrock is mineralized, and this fact alone augurs well for the discovery of auriferous veins. Moreover, some auriferous quartz veins have been found in nearly every placer district. The geology shows that the Alaska auriferous quartz is genetically related to intrusive granitic

and kindred rocks. Such intrusive rocks are widespread in the territory south of the crest of the Arctic Mountain system. The geologic conditions are therefore favorable to the occurrence of auriferous quartz veins. This fact has been generally recognized, and the question is often asked why more lode mines have not been developed. A partial answer to this question lies in the fact that in much of Alaska lode prospecting is beset by the difficulty that the bedrock is masked by a mat of moss and other vegetation. Therefore the lode prospector has little to guide his search except the distribution of placer gold. Moreover, there has been little incentive to lode prospecting. The inaccessibility of so much of Alaska has prohibited mining development except such as could be carried on with the simple tools and methods of the placer miner. Much of the placer mining has been done far from navigable rivers, where there were no roads and few, if any, trails. Under such conditions lode mining cannot thrive.

On the other hand, where a region has been made even reasonably accessible, small lode-mining industries have sprung up, as, for example, in the Willow Creek and Fairbanks districts. The evidence in hand indicates that gold-lode mining in Alaska has only begun, for there are many districts that contain evidence of the presence of auriferous veins. Though no quantitative statement of reserves of lode gold is possible, there can be little doubt that when normal economic conditions become re-established and transportation is provided, lode mining will be undertaken in many localities. It is quite possible that the reserve of lode gold far exceeds that of the placers.

Copper. The total copper production of Alaska to the end of 1919 has been 545,007,336 pounds, recovered from 3,736,000 tons of ore. The first copper-mine developments were in the Ketchikan district, but production began in 1900 in both the Ketchikan and Prince William Sound districts. The first large shipments of copper ore from the great Kennecott mine, in the Chitina district, were made in 1911, after the completion of the Copper River Railroad. At about the same time the Beatson-Bonanza mine, on Latouche Island, in the Prince William Sound region, was opened on a large scale. In 1913 the Jumbo and Mother Lode mines of the Kennecott group began shipping ore. These two, together with the original Kennecott

mine, are operated on very rich chalcocite ore, and it is their output which has so greatly swelled the copper output of Alaska. It was a fortunate coincidence that these rich mines should have been prepared to take advantage of the war prices of copper. The large output of copper ore from these three bonanza deposits has greatly benefited the industries of Alaska and has stimulated other copper-mining ventures. The Beatson-Bonanza, the only other large copper mine in Alaska, is working a large body of copper ore of much lower grade than that of the Kennecott group. This ore is concentrated by oil flotation before shipment. Most of the other copper mines are small and many are developing ore bodies which are not large and whose copper content is low. As a consequence of this condition and of high freight rates, many of the small mines have been operated only during the period of high price for copper.

Southeastern Alaska. All the productive copper mines as well as the largest developed cupriferous ore bodies of southeastern Alaska are in the Ketchikan district. Copper is widely distributed in the Ketchikan district and, as will be shown, occurs in deposits of several distinct types. The most important so far as present production and extent of proved ore bodies are concerned are the contact deposits, which have yielded more than 98 per cent of the copper produced in the Ketchikan district.

The Ketchikan copper deposits are not far from tidewater and are on good harbors open to navigation throughout the year. They are connected by sheltered waterways with the smelters at Anyox, Tyee, and Tacoma. This condition should give cheap freight rates. The strong topographic relief, excellent timber, and good water powers of the district all favor low mining costs.

A total of 543,498 tons of copper ore has been produced in the Ketchikan district since mining began in 1901. This ore yielded 34,056,376 pounds of copper, gold to the value of $545,000, and 255,440 ounces of silver. The average copper content of this ore is 62.66 pounds to the ton, equal to 3.13 per cent. The average value of the gold and silver content is $1.31 a ton. The average value of the total metallic contents of the ore is $12.71 a ton. No attempt has been made to concentrate the Ketchikan ore except by hand sorting. The small mines have normally maintained their shipping grade of ore at 5 per cent or more.

The facts above set forth clearly indicate that the Ketchikan district contains copper deposits which are well worth investigating by those who have the capital to develop and reduce ores on a large scale. The physical conditions seem almost ideal for cheap operations. Special attention should be directed to devising methods by which the iron content of the chalcopyrite-magnetite ores, as well as the copper, can be utilized.

Prince William Sound. Copper in the form of sulphides is very widely distributed on Prince William Sound, but as yet commercial ore bodies of this metal have been developed at relatively few localities. Though some shipments of copper ore have been made from a dozen different properties, only three large mines have been opened. Most of the mining has been done by those who had little capital and hence were forced to concentrate their efforts on the search for rich ore shoots that would promise immediate returns rather than on the prospecting of the larger ore bodies of lesser copper tenor, on which a more permanent industry could be established. As a consequence the present developments have not aided much in determining the potential value of the copper deposits of the region as a whole.

The first mining on Prince William Sound was done in 1900, and since then a total of 1,819,578 tons of ore has been produced, from which 94,185,716 pounds of copper, $1,099,176 worth of gold, and 772,749 ounces of silver have been recovered. The average copper content of the ore mined was 51.76 pounds to the ton, or 2.58 per cent. On an average 60 cents' worth of gold and 0.43 ounce of silver were obtained from each ton of copper ore. This average gold value is somewhat misleading, because much the larger part of the ore contains only an insignificant amount of gold. The average has been greatly increased by the high gold content found in part of the Ellamar ore body. The average value of the total metallic contents of the copper ores produced on Prince William Sound during 20 years of mining is $11.32 a ton.

Much the larger part of the above-stated tonnage is the output of the Beatson-Bonanza mine, where the ores are concentrated by oil flotation. Nearly all the copper deposits of this region are readily accessible from tidewater, and the ore can usually be delivered at the beach by aerial trams. It is transported to the smelters of Washington and British Columbia by ocean routes open to navigation throughout

the year. Given tonnage enough to justify the employment of suitable carriers, freight rates should not be high. On the other hand, should a sufficient tonnage be developed and local smelting of the ores prove to be economical, the necessary fuel should be made available from the high-grade coking and steaming coals of the Bering River and Matanuska fields or from the Cook Inlet lignites. It has been shown that some siliceous ores could be obtained locally and that limestone is not far distant.

The climate of Prince William Sound is no deterrent to operations throughout the year. Many of the ore bodies are topographically so located that they could be undercut. Timber, though not abundant, is ample for the purposes of mining. Small water powers are fairly abundant, and there are also some larger ones. During the era of high prices there has been a shortage of labor in all Alaska mining camps. As a consequence miners' wages on the Sound have of late been about 10 per cent higher than in the lode-mining districts of the States. Should copper mining ever develop on a large scale, there is no reason to believe that this difference would continue. On the whole, the controlling physical conditions on Prince William Sound are favorable to fairly low operating costs, though probably higher than in southeastern Alaska.

Copper River Region. The richest copper lodes of Alaska are those developed by the Kennecott group of mines and are tributary to the Copper River & Northwestern Railroad. These deposits are near the east end of a copper-bearing belt, which has been traced some 50 miles westward along the southern foothills of the Wrangell Mountains and as measured by present discoveries is from 5 to 15 miles in width. The belt takes its name, the Kotsina-Chitina district, from the two principal rivers which carry its drainage into Copper River. There is evidence that this zone of mineralization extends eastward into the upper Chitina basin. Some cupriferous lodes have also been found southwest of the main belt, near the valley of Copper River. All these deposits may be regarded as a part of the same copper-bearing province, which finds outlet to tidewater over the railroad terminating at Cordova.

The Kotsina-Chitina copper district is easily accessible by the Copper River & Northwestern Railroad, which extends inland for 192 miles from Cordova, a good harbor and ice-free port on Prince

William Sound. Outgoing shipments are on a down grade, and if a large tonnage were available reasonable freight rates should be expected. This railroad passes within 38 miles of the Bering River coal field, and a short distance beyond this is the Katalla oil field. These geographic facts would seem to favor the use of the copper deposits here described for the upbuilding of a local industry. The high-grade ores, with calcareous gangue, would meet ores of lower grade from Prince William Sound at Cordova, while near by there are sources of excellent fuel.

There is no great amount of timber in the Kotsina-Chitina district, but it is sufficient to meet the immediate needs of a mining industry. The district is one of strong relief, and most of the ore bodies now known could be developed by adits. There are some large water powers in this general region, but most of them are not near the ore bodies. There are no climatic conditions in the district which prevent mining throughout the year, though some difficulties are caused by snowslides.

Although the conditions above described are in general favorable to the developments of the copper deposits, the present situation presents many drawbacks. The railroad traverses the southern margin of the copper belt, making the district accessible as a whole, but many of the prospects are 5 to 25 miles from the track. No spurs have been built, and there are few wagon roads. This condition makes development work expensive. In the event of the opening up of large ore bodies this situation would of course be met by providing connection with the railroad by spurs or aerial trams.

The present freight rates on the railroad are high. The rates on ore and concentrates from this district to the Tacoma smelter in 1920 ranged from $11.20 a ton on ore worth $25 a ton to $40.90 on ore worth $500. The railroad company contends that as it is not making expenses it cannot afford to lower the rates. On the other hand, prospective operators hold that under the present rates no mining is possible except that of very high-grade ore. Consequently but little development work is now under way. It would appear to be the part of wisdom to lower the rates with a view of encouraging a development that would produce enough ore to make the railroad a profitable venture in the future. As it is, no ore is shipped except the high-grade product of the Kennecott Mines Co., which controls

the railroad. It should also be noted that there has not yet been a sufficient assured quantity of coal disclosed in the Bering River field to justify the extension of a branch line into the coal field, also that the Katalla oil field is as yet only a small producer. Aside from the question of freight rates, mining costs in the interior will certainly for a long time to come be higher than on the coast.

In view of these conditions an ore body of a given size and copper content which might if located on the coast be valuable, if in the interior would at present be worthless. Nevertheless the situation of the Kotsina-Chitina copper deposits with reference to sources of fuel and to the ores of a different character on the Sound presents possibilities which should not be underestimated.

Productive mining in the Kotsina-Chitina district began in 1911. Up to the end of 1919 about 1,360,000 tons of copper ore had been mined, from which about 417,700,000 pounds of copper had been recovered. In 1919 the district produced 195,631 tons of ore, carrying 36,291,390 pounds of copper and 408,726 ounces of silver. No gold has been recovered from the copper of this district.

Reserves. The reserve tonnage of the present Alaskan copper developments is small. On the other hand, the evidence of strong copper mineralization in several of the accessible mining districts of Alaska and the widespread distribution of copper ores give every assurance for the future. It can therefore be confidently predicted that Alaska's copper industry will grow when transportation is improved and general industrial conditions are revived.

Coal. Formations that are known to be locally coal bearing are widely distributed in Alaska and occupy an aggregate area of more than 12,000 square miles. About 80 per cent of Alaska is unsurveyed, and some of the unexplored regions may contain coal. It is therefore not impossible that the total area of the coal-bearing formations may far exceed 12,000 square miles. Any additions that may be made to the known coal reserves as a result of future explorations will probably not greatly increase the immediately available stores of fuel, which alone are here under discussion. Most of the regions tributary to the existing lines of transportation or those under construction are sufficiently explored to indicate whether or not they contain coal. Outcrops of coal are not easily overlooked, either during hasty exploration or by the prospector, and, therefore, the coal-

bearing areas already outlined in a rough way, though many have not been surveyed, probably include much the larger part of those that will be available for use in the immediate future. In any event, it is with reference to these known coal fields, and not to possible discoveries in unsurveyed tracts, that the future of the coal-mining industry must here be discussed. The Alaska reserves in general may be said to include enormous quantities of lignite, considerable low-grade bituminous coal, much smaller quantities of high-grade bituminous coal, and some anthracite. The bituminous coals are the highest-grade coals found on the west coast of the American continent and are comparable in composition to the best Appalachian fuels. It is on these high-grade coals that the present development of the coal-mining industry in Alaska depends, for they are the only fuels suitable for export.

There has been a little mining of lignitic coal at various places in Alaska since 1888. It was not, however, until the high quality of the Bering River and Matanuska coal was established by both public and private surveys and examinations, made between 1898 and 1905, that these northern coal fields excited any special interest. An Alaska coal-land law was enacted in 1904, but it proved, as interpreted, ineffective in encouraging mining development, nor did the supplementary legislation of 1908 serve to improve the situation. Meanwhile, all Alaska coal lands were withdrawn from entry by executive order dated November 12, 1906. Many coal claims were staked previous to this withdrawal, but patent was refused to all except a few that were isolated and too small in area to permit economic exploitation.

The Alaska coal situation was further embarrassed by the rapid increase in the petroleum output of California. As a result, the shortage of fuel of the Pacific seaboard that was threatening at the time of the first attempted development of Alaska bituminous coal was changed to an excess of production. The net result of these conditions was to prevent all coal-mining development in Alaska and to force Alaskan industries to draw on foreign sources for fuel. Furthermore, the projects for private railroad construction to the coal fields were necessarily abandoned. The logic of the situation forced the government to enter the field of railroad construction and also to undertake the underground exploration of the coal fields at public expense.

The long and bitter controversy regarding an Alaska coal-land policy ended in 1914 with the enactment of a leasing law. As a consequence of the relative decrease in the market for coal, because of the large use of petroleum and the unsettled financial conditions brought about by the war, no great eagerness has been shown by capitalists to enter upon the development of the Alaska coal fields. Furthermore, the little underground work thus far done has more than confirmed the incomplete evidence obtained from surface exposures as to the greatly folded and broken condition of the coal beds in both the important fields. Most American coal mining has been done on beds that are but little disturbed. Hence those engaged in the industry have had little experience in the exploitation of greatly disturbed coal beds such as those of Alaska, which are, however, comparable to some of those mined in France and Belgium. Many have also contended that the terms of the coal leases are not sufficiently liberal, in view of the isolation and unprospected condition of the Alaska field. As a result of these conditions only one considerable coal-mining operation under leasehold is underway, and this has not yet reached a productive stage.

Between 1899 and 1919 Alaska mines produced a total of 243,677 tons of coal, of which 190,000 tons is the output of the last three years and is chiefly from the government mines. During the same two decades the Territory has consumed a total of 2,411,947 tons of coal. Of this amount 1,276,600 tons has been imported from the Vancouver fields in British Columbia.

The market for these high-grade bituminous fuels is ample to absorb all the coal that can be produced for a number of years to come. The coal consumption of the Pacific Coast States and Alaska, exclusive of that used on railroads and steamers, is now about 3,200,000 tons annually, of which 200,000 to 300,000 tons is imported from British Columbia. Railroads in the Pacific Coast States consume about 2,000,000 tons, practically all used in Washington. The bunker coal supplied to steamers at American Pacific ports amounted to 343,000 tons in 1915 and 474,000 tons in 1918. This bunker trade is one for which the Alaska coals are especially well suited. Some of the Alaska coals are also well adapted for coking. About 200,000 tons of coking coal is used in the Pacific Coast States. Of the Pacific Coast coals only those from Alaska are of sufficiently

high grade to be suitable for navy use. An estimate of the needs of the navy at 200,000 tons, of Alaska at 100,000 tons, and of coking coal at 200,000 tons would give a certain market for 500,000 tons. In addition to this the Alaska fuel should be a strong competitor in the bunker trade. Furthermore, the increased cost of petroleum will soon enlarge the market for coal on the Pacific seaboard. One adverse factor that should be considered is the competition of the high-grade Alaska coals with those from the East brought through the Panama Canal. Owing to the physical conditions under which the eastern bituminous coals occur they are cheaper to mine than those in Alaska, and another advantage lies in the more favorable industrial conditions. It is probably safe to assume, however, that even under this competition Alaska coal should have a market for at least 1,000,000 tons. Whether any such production can be reached in the immediate future can be determined only by further prospecting.

Petroleum. The Alaska oil lands were withdrawn from entry in 1910 and thereby practically all petroleum development was stopped until the passage of the leasing law in 1920. In spite of this handicap some 53,000 barrels of petroleum have been produced in the Katalla field. Meanwhile, Alaska is drawing on California annually for nearly 500,000 barrels of petroleum and petroleum products. This does not include the oil consumed by steamers running to Alaska ports. The information afforded by seepages indicates that there are five oil fields in Alaska which could probably be made productive. So far as known the Alaska petroleum is a high-grade refining oil for which there is at present a great need. Therefore the development of the Alaska petroleum fields is not only of great importance to the Territory but also to the entire nation.

5. POSSIBLE AGRICULTURAL DEVELOPMENT IN ALASKA[1]

The inside route from Seattle to Alaska is by a winding, narrow course, over still waters, through archipelagoes of mountain islands that front the mainland all the way from Puget Sound to Skagway. The 1,000-mile journey is a boat ride through mountain canyons.

[1] Adapted from Levi Chubbuck, "Possible Agricultural Development in Alaska," *United States Department of Agriculture, Bulletin No. 50,* pp. 1–30. Mr. Chubbuck formerly was Agriculturist in the Office of Farm Management.

The mountains on both mainland and islands are snow capped, and coming from the snow fields are numerous waterfalls that are emphasized by the dark cloak of spruce that drapes the land from the water's edge to snow line.

The mountains increase in height and consequently in extent of snow fields toward the north. The tourist naturally concludes that this is the result of the higher latitude. After four or five days' travel northward glaciers are seen on the sides of the mountains. When near Juneau the steamer may turn from its course and run into Taku Inlet, to give the passengers a near view of a glacier that reaches tidewater and is discharging icebergs into the sea.

With many of the tourists Juneau, the capital of Alaska, or Skagway, 100 miles farther north and the end of navigation by this route, is as far as they go, possibly returning to Seattle on the same boat. If this is so, all they have seen of Alaska is a 400-mile stretch of channel between the forest-covered mountains that constitute the 100-mile wide strip of southeastern Alaska. If they go on to Seward, the end of the steamer run, with calls at Cordova and Valdez, traveling nearly 1,000 miles farther along the south coast of Alaska to the westward, they will see magnificent views of other mountains, glaciers, and illimitable fields of snow. The tourist has traveled nearly 2,000 miles from Seattle by this route, but he has seen only the narrow southeastern projection of the territory and a small section of the south coast of the mainland. He has seen, however, what has given to the world the most commonly accepted opinion of Alaska. Erroneous as is the opinion thus developed of the Territory as a whole, it is the more remarkable that it is quite as far wrong respecting the portion that comes under observation, for, notwithstanding the prevalence and close proximity of the snow and ice fields on the south coast, the fact remains that this portion of the Territory has a comparatively mild climate. To get a clear understanding of how this can be and of Alaskan climatic conditions in general, a brief description of the physical features of Alaska will be in order and necessary to a consideration of the agricultural possibilities.

Alaska comprises the northwestern end of the continent. The Territory all lies west of longtitude 141° W., excepting the narrow strip that extends from Mount St. Elias along the shore southeastward

some 600 miles, the extreme southern point touching latitude 54° 40′ N. The long projection extending out from the southwestern coast, forming the Alaska Peninsula and the Aleutian Islands, goes so far to the southwest that the farthermost island, Attu, is in the longtitude of New Zealand, 173° E. The mainland is about 700 miles from north to south and 700 to 800 miles from east to west. The total area is 586,400 square miles. This area is thrust out from the main continental land mass, so that it is surrounded on three sides by great bodies of salt water differing greatly in temperature. The Arctic Ocean is on the north, Bering Sea on the west, and the Pacific Ocean on the south. The waters of the first are very cold, of course, because of the drift from the polar region. This drift extending through the Bering Strait makes the Bering Sea also quite cold. The drift of warm water from the southern Pacific Ocean northeastward modifies quite markedly the temperatures along the south coast, just as it does all along the western coast of the United States. Quite different climatic effects are thus produced on their respective shores by these different bodies of water. How far these effects extend inland depends much upon the topography of the country.

Pacific Mountain System. The Pacific Mountain system, which fronts the south coast of Alaska, demands attention, for it is not only that which has developed public opinion regarding Alaska, but it is the dominating physical factor. It is the extension of the Coast Range of the United States and Canada. North of Puget Sound the sea has broken into the mountain fastnesses along a 1,000-mile stretch until the St. Elias Range is reached, where, with increasing height, the sea is forced back outside of the coast line. Northwestward from Mount St. Elias the range widens into a system, with the Chugach and Kenai mountains immediately on the coast, and back of these the Wrangell and Nutzotin mountains. These, with the minor ranges, merge into the Alaskan Range that swings southwestward and continues out on the Alaska Peninsula as the Aleutian Range, the whole mass forming the arc of a great circle. The system, extending in width from the water's edge to 200 miles back from the coast, is of great altitude, the maximum being Mount McKinley, in the Alaskan Range, 20,464 feet.

Right here in this mountain mass, occupying an area 200 by 400 miles in extent, is the dominating fact that always must be borne

in mind when studying Alaska, namely, the effect on the moisture with which the warm air currents from the sea are laden. The moisture in the air is condensed and precipitated as snow on the high levels and as rain lower down, 90 inches being the average annual precipitation at Sitka, while at a number of points on the coast in southeastern Alaska 150 inches annually have been recorded. This heavy snowfall at the higher levels, accumulating through the ages and solidifying into ice, forms the great glaciers, and we have here on the south coast of Alaska in this 200 by 400 mile area, much of which lies plainly in sight from the decks of steamers, the most extensive permanent snow and ice field in the world, outside of the polar region. In fact, nearly all of the permanent snow fields and glaciers of Alaska are in this area, there being, strange as it may seem, comparatively few that lie wholly north of the Arctic Circle, even in the Arctic mountain system. At the shore line of this same south-coast snow and ice field, in sight of the great glaciers, the temperatures are so high in winter that zero is rarely reached. The winters at Sitka, Juneau, and other points in southeastern Alaska are never as cold as they are at Washington, D.C., though the mean annual temperatures are about the same, the summers on the Alaskan coast being cooler than those in Washington. But it does not follow that because the south coast has a mild climate the conditions are favorable for agriculture. The cool summers and excessive precipitation, with much cloudy weather, are distinctly unfavorable, excepting for the growth of grass, garden vegetables, and small fruits. Vegetation is slow in maturing, and the curing of hay and grain quite difficult; to which may be added the fact that land available for tillage is very limited because of the mountainous topography.

The south portion of Alaska is a heavily timbered area, a natural result of the heavy precipitation and equable temperatures. The timber is largely spruce, with some hemlock, and groves of poplar on the alluvial bottoms. Proceeding southwestward along the Alaska Peninsula and adjacent islands, the timber decreases and disappears entirely beyond the north end of Kodiak Island. The islands and mainland are quite mountainous, level land being limited to narrow strips along the beaches and to the numerous coves that indent the shores. Grass in great variety and luxuriance clothes the land from water and snow line and makes this the best grazing area of Alaska.

Central Plateau Region. The great interior of Alaska is essentially a mountainous area, although the mountains between the Endicott Range on the north and the Alaskan Range on the south are more or less detached and of quite moderate altitude.

Level areas in the interior are for the most part limited to the alluvial bottoms along the streams. The most pronounced exception to this is in the Yukon Flats. About 200 miles downstream from Eagle the river passes into an area 150 miles long and 50 to 75 miles wide that is quite level. The river banks are low and the stream divides into innumerable channels, thus forming a myriad of islands. Dense growth of spruce and poplar occupy the land, with occasional grass meadows. For the most part the bottom lands comprise a strip on one or both banks of the larger streams, rarely exceeding a couple of miles in width. Next to the bottoms there may be benches which merge into low hills, and these into the mountains that make up the larger proportion of the area. The bottom, bench, and low hill lands are, of course, those that are suitable for farming, the higher hills and mountains being more or less available for grazing.

The low hills having a southern exposure, and particularly if covered with a growth of birch, are the best suited to tillage. The benches with comparatively high banks above the streams and free from gravel banks are the next best. The low-lying bottom lands, lacking both water and air drainage, are the least desirable for farming purposes.

The largest area of tillable land thus far located in the interior is in the Tanana Valley, extending 20 to 30 miles above Fairbanks and downstream to the junction of the Tanana with the Yukon. The Kuskokwim River, which rises on the northwestern slope of the Alaskan Range and flows southwest into Bering Sea, occupies a great and little-explored region, and it is quite possible that there are large tillable areas in its valley.

Small areas of land for gardens may be found even above the Arctic Circle along the Koyukuk, Chandalar, and other Yukon tributaries that come in from the north. The Kobuk River, which empties into Kotzebue Sound above Seward Peninsula and lies wholly above the Arctic Circle, is said to offer some farming and gardening possibilities.

Climate of the Interior. Climatic conditions of the interior are determined by the latitude and its relation to the bodies of water and

mountain systems already mentioned. Much of the area of the interior, particularly the Tanana Valley and the upper Yukon Valley in Alaska, lies north of latitude 64° N., and extends above the Arctic Circle. Cut off from the tempering influence of the warm waters of the Pacific that have so much effect at the coast, both with reference to temperature and precipitation, the result is light precipitation, short but quite warm summers, and long, cold winters. It must be remembered that, while the summers are short in number of days, there are 18 to 20 hours of sunshine daily during the growing season, and that this, with comparatively high temperature, causes very rapid growth of vegetation. The lower Yukon and Kuskokwim region is in a lower latitude, but this is counteracted by proximity to the cold waters of Bering Sea, with no protecting mountain range to arrest the cold air currents.

As a result of the long winters, and, generally speaking, low temperatures, during which the ground is deeply frozen, and the short summers, there is frozen earth even in the summer time within a few feet of the surface over much of Alaska. Because of this frost line the moisture from the melted snow on the ground and the frost in it cannot drain away and can escape only by evaporation. This condition of slow melting and evaporation is emphasized by the vegetable growth and particularly the moss, which is a most efficient nonconductor of heat as well as an excellent sponge for holding moisture.

Over much of Alaska during the summer there is, then, a thin stratum of saturated earth with its protecting coat of moss or other vegetation, forming for the most part a morass impassable for wheeled vehicles and almost impassable for horses. Land travel by teams is therefore practically out of the question in Alaska during the summer, even where the mountains and timber growth do not interfere. But with a coast line of 26,000 miles and 6,000 miles of navigable rivers, one of which, the Yukon, bisects the territory with a 1,500-mile waterway, Alaska is marvelously well supplied with facilities for water travel during the summer season. But as the streams are icebound from early in October until June and only the harbors on the south coast are ice-free during the winter, the dog team and sled are still the most general and widely used mode of conveyance in winter, although horses are being used more and more during this season on established lines of travel.

Vegetation of the Interior. Practically all of the interior that comes within our purview as possessing agricultural possibilities is timbered, but for the most part the growth is small and thin. Spruce is the most prevalent. There are belts of balm of Gilead poplar at the lower levels and quaking aspen near the snow line. Birch groves occupy many of the benches and low hills adjacent to the river bottoms. If not destroyed by fire and undue waste, there is enough timber in the interior to meet the needs of a largely increased population.

Grasses in great variety are native to Alaska and are widely disseminated, many of them being of large agricultural value for hay and silage and for grazing. Wherever the timber is destroyed by fire or cut away, grasses at once spring up and make a luxuriant growth.

Other native vegetation of agricultural economic value includes a considerable variety of wild fruit—salmon berries, red and black currants, gooseberries, cranberries, blueberries, and other edible small fruits that are found in plentiful quantities over wide areas.

The most widespread forms of plant life in Alaska are the mosses and lichens, and they claim attention both for their agricultural value and because they are also an obstacle to agricultural development. One of the lichens known as reindeer moss grows widely in the western half of Alaska and in all that portion north of the Yukon. It is the principal winter food of the domesticated reindeer.

Reference has been made to the water and frost holding characteristics of the moss growth. It is this that makes the moss an impediment to agricultural development in sections where tillage is feasible. It appears to decay very slowly, as is the case to a certain extent with all vegetable matter in localities where there are but brief periods of warm weather, so that a coat of moss varying in thickness from a few inches to a number of feet accumulates over much of the land surface. Even in those portions of Alaska where the winters are comparatively mild, but the summers cool and moist, the frost will be so near the surface under a coat of moss that at any time during the summer a cane may be thrust through the moss to the frost line. Under these wet and cold conditions and the slow decay of the vegetation the soil is quite acid, as is evidenced by much of the plant growth, the species being those that grow on land that is too sour for most farm crops. When the timber and other plant growth, including the moss, is removed from the land, thus giving the heat of the sun and the air a

chance to penetrate the soil and dry out the moisture, the frost line goes lower each season until it ceases to be an injurious factor, and in the meantime the acidity of the soil grows less.

The Soils of Alaska. Alaskan soils have their origin largely in material formed by glacial action. They are not very rich in available plant food, as a rule. The vegetable matter that has accumulated on the surface is in such a partially decayed and acid condition that it is quite apt to be injurious to some cultivated plants. This is quite pronounced even in the regions of mild temperatures and abundant rainfall, as in southeastern Alaska, where vegetation is luxuriant and the soil is apt to be quite peaty and mucky. In fact, extensive beds of peat exist in various portions of Alaska. Wherever there has been sufficient drainage and the vegetable matter has fully decayed there is a rich black loam of varying depths; but these areas are limited to small valleys, some of which are the dried-up beds of former shallow lakes. The alluvial deposits along the larger streams contain good soil, but there are many gravel beds that have only a thin covering of fertile soil. Much of the soil, particularly of the benches and low hills, is composed largely of material deposited by the melting of the ice sheet that formerly covered the land.

Drainage is an important and widespread need in Alaskan agriculture, not merely in the southeastern section where the rainfall is so abundant, but in the interior where the precipitation is so light that irrigation is thought by some to be a possible essential. Wherever the soil is at all peaty, from the accumulation of partly decayed vegetable matter, drainage will greatly improve the condition. Shallow lakes and partially dried lake beds abound, and the draining of these will make available for tillage much good land and will be otherwise beneficial. It is noticed that wherever the tundra moss is disturbed in such a way that drainage has resulted incidentally, as has been done at St. Michael in connection with building operations, grasses come in and make a luxuriant growth.

Notwithstanding the need of drainage, even in the interior, as has been stated, some of the settlers are of the opinion that irrigation will be necessary in certain localities, and a few have installed irrigation systems. It is not probable, however, that irrigation will be a general or pressing need. The ground is usually frozen to a great depth during the long and severe winters and, of course, thaws

quite slowly after the frost line has fallen a foot or so. So long as there is frost in the ground drainage will be retarded, and as the frost slowly melts it will supply moisture by capillarity to the surface soil. The shortness of the growing season and the tendency of vegetation to rapid growth and early maturity under the influence of the almost continuous sunlight will lessen the need of irrigation.

Possible Agricultural Areas. So far as topography, soil, and climate determine the matter, Alaska has probably 100,000 square miles of area on which there are possibilities for farming and grazing.[1] The larger portion of the farming land is in the interior, in the Yukon Drainage Basin. Notwithstanding the mildness of the climate and the accessibility of the south coast, the precipitous topography to the water's edge makes tillable land very limited, particularly in the southeastern section, where the excessive precipitation and much cloudy weather are also agricultural handicaps. Of tillable land contiguous to the south coast from southeastern to southwestern Alaska, probably not more than 1,000 square miles are available. In the Copper River drainage, 100 miles back from the coast, there are possibly 2,000 square miles of such land, and not less than 3,000 square miles in the Cook Inlet region, including the Matanuska and Susitna drainage areas. It is estimated that there are 8,000 square miles of tillable land in the Tanana Valley and possibly twice that area in other portions of the Yukon Drainage Basin, much of this being in the Yukon Flats.

It is hardly necessary to prove that agriculture is feasible in Alaska other than by citing examples of successful gardening, farming, and stock raising at widely separated points. First in importance are the agricultural experiment stations of the United States Department of Agriculture; one at Sitka, the headquarters station, in southeastern Alaska; one at Kodiak, in the southwestern portion; and two in the interior, one of which is at Fairbanks on the Tanana and one at Rampart on the Yukon, the latter being within 75 miles of the Arctic Circle. "Alaska contains extensive areas of farm lands suitable for raising the hardier grains, including wheat, potatoes, forage crops, and many varieties of vegetables. Tests have shown that sugar beets can be matured in the Tanana and Susitna valleys, and that these contain a high percentage of sugar. The most promis-

[1] 1920 estimates reduce this to 65,000 square miles.

ing agricultural fields are in the Tanana and in the Susitna Valley, both tributary to the government railroad. Extensive areas of agricultural land are also found in other parts of the Yukon Basin, and in lesser amounts in some of the Pacific coastal region.

The best-developed farming region is that tributary to Fairbanks. In this region there are 102 homesteads, with about 2,000 acres of land under cultivation, and with an agricultural population of about 250. These farms produced, in 1919, 60 tons of wheat, 40 tons of oats, 10 tons of barley, 500 tons of hay, 325 tons of potatoes, 60 tons of vegetables, and 150 hogs. The success during the last five years in the raising of wheat has so encouraged the farmers and local business men that they are now building a small flour mill at Fairbanks. There is a little dairying at Fairbanks, and in other parts of the Territory, but the raising of cattle has not yet been greatly developed in connection with other farming."[1]

Cattle and Sheep Raising. A cattle and sheep raising industry "ties on" to the reindeer industry in southwestern Alaska. The animal-husbandry experiment station of the United States Department of Agriculture is at Kodiak on Kodiak Island where a herd of Galloway cattle and a flock of sheep are maintained. Private individuals and companies are also establishing stock ranches on this and adjoining islands. Unsurpassed cattle and sheep grazing is found on these islands and on the mainland of the Aleutian Peninsula near the shore, while in the mountainous interior there is said to be good reindeer grazing ground.

Winter forage for cattle and sheep is provided largely from the native grasses, both hay and silage being made.

The next most extensive and favorable grazing area in Alaska for domestic cattle and sheep is in the Tanana Valley, including also portions of the upper Yukon Valley and extending from the international boundary westward to the confluence of the two streams named. Other more or less favorable grazing areas are in the Copper River drainage, the Susitna drainage, on the Kenai Peninsula and in the upper valley of the Kuskokwim River. The practicability of

[1] Taken from "Report of Alaska Advisory Committee," appointed by Hon. John Barton Payne, Secretary of the Interior, in *Report of the Governor of Alaska to the Secretary of the Interior*, 1920, p. 107. The chairman of this committee was Alfred H. Brook of the United States Geological Survey.

raising stock in these areas, other than in small herds in quite close proximity to individual farms, has not been investigated with sufficient care to warrant more than an intimation of its possibilities. The long winters with very low temperatures at all points behind the mountains that front the south coast, the boggy and moss-covered condition of the greater portion of the land, the prevalence of mosquitoes and other insects that are very trying to cattle and horses, and numerous carnivorous animals are serious obstacles to the development of a larger grazing industry, other than with reindeer and (except as has been noted) in southwestern Alaska.

The Reindeer Industry.[1] Between 1892 and 1902 the government imported 1,280 reindeer into Alaska for the use of the Alaskan natives. The natural increase from the original stock has resulted in a herd numbering nearly 200,000, besides which about 100,000 have been killed for food and skins. Of these about 69 per cent belongs to the natives, 5 per cent to the missions, 23 per cent to Laplanders and other whites, and 3 per cent are still in government ownership.

There is a company at Nome which engages in raising reindeer for the market. Their herd now includes nearly 20,000 animals, and they have 3 cold storage plants in operation and 2 more in construction. Shipments of reindeer meat are limited to cold storage capacity of steamers running to Nome, and were 99,000 pounds in 1918, and 37,000 pounds in 1919.

There are extensive reindeer pastures in inland Alaska, and on the shores of Bering Sea and the Arctic Ocean. It is estimated that these pastures should support a total of 9,000,000 to 10,000,000 animals. The reindeer range tributary to Broad Pass, and hence to the Alaska Railroad, should be capable of supporting some 600,000 animals. This, if utilized, will give tonnage to the railroad and would furnish a new source of meat and leather from a region which has no value for other purposes.

"The reindeer enterprise in Alaska has successfully passed through two stages—the introduction of the reindeer to a new country and people, and the development of an administration which has established the industry in the coastal region from Point Barrow

[1] Taken from "Report of Alaska Advisory Committee," appointed by Hon. John Barton Payne, Secretary of the Interior, in *Report of the Governor of Alaska to the Secretary of the Interior*, 1920, pp. 107–8.

to the Aleutian Peninsula. There remains the successful commercializing of the industry, the advancement of the enterprise from a branch of industrial education to one of the industries of the country."[1]

6. FOREST RESOURCES OF ALASKA[2]

The differentiations between forest types are as sharp as those between the topographic and climatic, and, of course, depend upon them. The coast forests of southern Alaska are the northernmost extension of the coast type of Washington and British Columbia. The interior forests are an extension of the interior Canadian forests. The forests of the Susitna and Copper River basins are somewhat intermediate in character, since these rivers rise in the interior and break through the mountain barrier to the southern coast.

On the coast of southeastern Alaska trees grow to large size; in the interior the timber is much smaller. The higher mountain areas are completely above timber line. Climatic conditions in the region adjacent to Bering Sea and on the Arctic slope make forest growth altogether impossible, so there are great stretches of tundra whose vegetation consists chiefly of moss, sedges, and a few small shrubs. Moss may be said to be the garment of Alaska, and layers of it 12 to 18 inches thick are not at all uncommon either on the coast or in the interior.

It is estimated that the total forest and woodland area of Alaska is approximately 100 million acres, or about 27 per cent of the land surface of the territory. Of these, about 20 million acres may possibly bear timber of sufficient size and density to be considered forest in the sense that much of it can be used for saw timber, while the balance, or 80 million acres, is woodland which bears some saw timber, but on which the forest is of a smaller and more scattered character and valuable chiefly for fuel.

[1] Taken from "Report on the Work of the Bureau of Education for the Natives of Alaska, 1914–15," *Department of the Interior, Bureau of Education, Bulletin, 1916, No. 47*, p. 8.

[2] Adapted from R. S. Kellogg, "The Forests of Alaska," *United States Department of Agriculture, Forest Service, Bulletin 81* (1910), pp. 13–22. When this article was written Mr. Kellogg was assistant forester in the Department of Agriculture.

There is not sufficient information upon which to base any satisfactory estimate of the total stand of timber in Alaska. It has been estimated, for instance, that the coast forests contain 75 billion feet of merchantable saw timber, but this estimate might be much exceeded were both the spruce and hemlock closely utilized. More than twenty cords per acre have been cut in good stands of birch and aspen in the interior, but, on the other hand, there are large areas of black spruce that are too small to use for any purpose; so that it is still impossible to give a satisfactory estimate of the total stand.

The Coast Forests. The coast forests of southeastern and southern Alaska are nearly all included in the Tongass and Chugach National Forests, which comprise 26,761,626 acres, approximately 5 per cent of the total area of Alaska; and a large proportion of this area is forested.[1] The species are chiefly western hemlock, Sitka spruce, western red cedar, and yellow cedar, with occasional specimens of lodgepole, or chore, pine, black hemlock, Alpine fir, black and white spruce, balm of Gilead, locally known as balsam poplar, black cottonwood, Oregon alder, and several birches and willows. Sitka spruce and hemlock grow almost everywhere in this region, though in Kenai Peninsula the spruce extends farther westward than the hemlock and grows also on Kodiak Island. The cedars grow in commercial quantities only in the extreme southeastern part, though yellow cedar is occasionally found in the Chugach Forest. Lodgepole pine grows as far north as Skagway, but is of no commercial importance.

On the coast the timber line is low. On Deer Mountain at Ketchikan, for instance, spruce saw timber stops at about 1,500 feet, and the peak, with an elevation of 3,000 feet, bears only stunted black hemlock.

In the coast region the stand is generally dense, and as much as 25,000 feet per acre has been estimated for considerable tracts. Sitka spruce probably averages 20 per cent of the stand, and western hemlock about 75 per cent. The spruce reaches a large size, and occasionally attains diameters of more than 6 feet and heights of 150 feet. Diameters of 3 to 4 feet are attained by western red cedar. While by far the most abundant species, western hemlock does not

[1] In 1920 the Forest Service estimated that the national forests of Alaska included 77,000,000,000 feet (B.M.) of timber suitable for lumber and pulp.—C. C. C.

produce as large individual trees as the spruce or the cedar. The heavy rainfall causes an undergrowth of moss and brush which completely covers the surface except where it is too rocky or too steep. So dense is this surface covering that one may walk long distances without touching bare soil. Water exudes from the moss when it is stepped upon, as from a sponge, and consequently there is little or no damage by fire in the coast forests.

Logging in southeastern Alaska employs the crudest of methods. It is now carried on entirely by hand, though logging machinery was used in a few earlier operations. Only the best spruce trees at the edge of tidewater are cut. The logs are frequently made the entire length of the tree, and are jacked up and rolled into the water, where they are tied into rafts and towed to the sawmill by tugs.

The annual lumber cut in the coast forests of Alaska is about 27,000,000 board feet. This consists almost entirely of spruce, since hemlock is but little used. There are about twenty-five sawmills on the coast, most of them rather crude in character and of small capacity. A large proportion of the output, probably more than one-third, is used for salmon cases, and much of the best lumber goes into them.

The southern and southeastern coast of Alaska has a much greater timber supply than there is any reason to think will be needed locally for a long time to come. The permanent industries of the region are fishing and mining. The mountainous character of the country will forever prevent agricultural operations of any magnitude. The total stumpage is large, much of it overmature, and the proportion of hemlock too great. The timber should be cut and utilized as soon as possible and the spruce, which is more valuable than the hemlock, should be given an opportunity to increase. Under present conditions, with the well-known ability of the hemlock to reproduce under shade and upon decaying logs and débris, it has the advantage of the spruce.

Since the Alaska coast forests do not contain timber of either as high quality or as great variety as grows in Oregon and Washington, there is little likelihood that lumber from them will compete largely in the general market with lumber from those states. In fact, some lumber used in southeastern Alaska is imported from the Pacific Coast States, but good management on the part of the Alaska mills

should enable them to supply the home demand for common kinds of lumber.[1] While Alaska may eventually export considerable material of this sort, it must continue to import timber like Douglas fir for heavy construction work. Utilization for other purposes than for lumber should be encouraged. The most promising of these is for pulp. Both the spruce and hemlock are undoubtedly good pulp woods, and, taken together, they comprise almost the entire forest.

There is a supply of water, without storage, for six or eight months of the year, for the needs of pulp mills, and transportation to the States through the inside passage to Seattle would be quick and cheap. The country is mountainous, it is true, and logging appears difficult, but much of it would be no more difficult than that of the Pacific Coast, and modern ingenuity can safely be relied upon to get most of the timber out as soon as there is a market for it.

The Interior Forests. The forests of interior Alaska are practically all included within the drainage basins of the Yukon and Kuskokwim rivers. They are chiefly of the woodland type, and are estimated to cover approximately 80 million acres, but probably not more than 40 million acres bear timber of sufficient size and density to make it especially valuable for either cord wood or saw logs. The three species include white spruce, white birch, balsam poplar, black cottonwood, aspen, black spruce, and tamarack. Of these the white spruce is the most important, since it furnishes the only saw timber of the region and is also much used for fuel. White birch is extremely abundant, as are also poplar and aspen, in many localities. Black spruce is of general occurrence and abundant. Mixed forests of all species are common, though there are occasional pure stands of each species.

[1] "The annual production of timber in Alaska is relatively small, but the proportion of timber cut from the National Forests, as compared with lumber imported, is steadily increasing. In 1906 the lumber shipped into Alaska composed 86 per cent, as compared with 14 per cent cut from National Forests. In 1919 the proportion was exactly reversed, 86 per cent being produced locally and 14 per cent imported, chiefly Douglas fir for heavy construction purposes. Alaska Sitka spruce is now being exported as far as the Atlantic Coast for specialized use, and the birch will also in all probability find an export market."—*Report of the Governor of Alaska to the Secretary of the Interior*, 1920, p. 107.

The best timber of spruce, birch, and poplar grows in the valleys of the streams, particularly along the Tanana, and excellent stands of birch and aspen are found also on the easterly and southerly slopes of creeks which have a silt soil. This is particularly true in the Fairbanks district. Black spruce predominates in the more poorly drained situations. Here, as farther south, it is characteristically a swamp and muskeg tree, though in some places abundant on hill and mountain slopes. Tamarack grows sparsely in river and creek valleys, but is nowhere of particular importance.

The stand in the interior forests varies from practically nothing in areas of scrubby black spruce to 20 or more cords per acre in the birch-aspen type, and several thousand board feet per acre in the best white-spruce forest. The average of the timber is small throughout; white spruce rarely and balsam poplar sometimes attain diameters of from 18 to 24 inches. The average diameter in white birch and aspen stands is about 8 inches, though maximums of 18 inches on unusually favorable sites were noted for these species. Black spruce rarely attains a diameter of 6 inches, and the less abundant tamarack is even smaller. The best white-spruce trees are about 75 feet high. Birch, aspen, and poplar usually reach a height of about 50 feet; black spruce rarely more than 40 feet, many times not exceeding 20 feet, and tamarack seldom more than 30 feet. Naturally, it is impossible for timber to grow rapidly or to large sizes in soil which is perpetually frozen. On such sites the roots can penetrate only the overlying cover of moss and humus and must spread out flat upon the frozen layer beneath. Rapid and thrifty growth has taken place only upon warm slopes and in river valleys with sandy soil, where the roots are able to go deeper. As the people in the interior of Alaska depend almost entirely upon wood for heat, light and power, the bulk of the timber cut is for firewood. Unlike the coast forests, the interior forests have suffered much from fire. Probably ten times as much timber has been killed by fire as has been cut for either fuel or lumber.

7. ALASKAN FISHING AND FUR INDUSTRIES[1]

The total value of the Alaska fishery products up to the close of 1919 is $418,042,000. Measured from the standpoint of value of

[1] Adapted from *Report of the Governor of Alaska to the Secretary of the Interior, 1921*, pp. 35–36; "Canned Salmon," *Report of the Federal Trade Commission on*

annual product and men employed, the fishing industry is the most important of the Territory. It was especially prosperous during the war, the value of its total output increasing from $15,739,068 in 1913 to $59,144,859 in 1918. The number of employees rose from 24,263 in 1913 to 31,213 in 1918.

In 1920 the total value of the products of the Alaskan fishing industry, exclusive of aquatic furs, amounted to $41,429,124. Of this total the largest item was canned salmon with a value of $35,602,800. The value of the fishery products varies from year to year because of (1) variations in the run of the fish, (2) the weather during the fishing season, (3) operating agreements limiting production brought about by combinations of the principal packers, and (4) the activity of the market.

TABLE XL

INVESTMENTS IN THE FISHERIES OF ALASKA IN 1919

Fisheries	Southeast Alaska	Central Alaska	Western Alaska	Total
Salmon canning	$33,741,891	$12,897,947	$19,855,333	$66,495,171
Salmon mild-curing	741,635	....	....	741,635
Salmon pickling	....	236,261	354,161	590,422
Salmon fresh	104,336	....	....	104,336
Salmon dry-salting	....	....	103,862	103,862
Halibut fishery	1,979,457	....	....	1,979,457
Herring fishery	418,571	431,338	50,663	900,572
Cod fishery	....	938,699	347,376	1,286,075
Whale fishery	545,256	....	1,245,611	1,790,867
Clam fishery	....	147,167	....	147,167
Crab fishery	200	....	....	200
Shrimp fishery	41,796	....	....	41,796
Total	37,573,142	14,651,412	21,957,006	74,181,560

In 1919 there were 28,534 persons engaged in the fishing business in Alaska. Of these, 13,356 were in southeastern Alaska, 5,699 in Central Alaska, and 9,509 in western Alaska.

The Alaska salmon catch has probably reached its maximum and any effort to a more intensive development of these fisheries would

Canned Goods, p. 14; Ward T. Bower, "Alaska Fisheries and Fur Industries in 1919," *United States Department of Commerce, Bureau of Fisheries, Document No. 891*, pp. 36–37. Mr. Bower is agent in the Alaska service of the Bureau of Fisheries.

lead to their rapid depletion. Given proper safeguards against overfishing, the salmon fishing industry of Alaska can be made to yield a large and continuous annual return.

TABLE XLI

THE DEVELOPMENT OF THE SALMON CANNING INDUSTRY BY PRODUCING DISTRICTS (CASES)*

Year	Outside Rivers	Columbia River	Puget Sound	Alaska	British Columbia	Total
1864. . . .	2,000	....	....	....	....	2,000
1870.	....	150,000	....	....	....	150,000
1880.	83,522	530,000	5,100	6,539	61,849	687,010
1890.	72,074	435,774	8,000	682,591	411,257	1,609,696
1900.	108,641	358,772	469,450	1,548,139	606,540	3,091,542
1910.	183,271	391,415	567,883	2,413,054	760,830	4,316,453
1915.	189,130	558,534	1,269,206	4,489,016	1,133,381	7,639,267
1916.	192,077	526,683	691,625	4,970,544	995,065	7,375,994
1917.	169,562	554,726	1,946,241	5,914,088	1,577,485	10,162,102
Total to date. .	5,527,907	20,150,239	19,823,422	63,617,615	23,812,168	132,931,351

* Figures down to and including 1915 from Bureau of Fisheries' report. Figures for British Columbia in 1916 and 1917 from *Pacific Fisherman's Yearbook* "Total to date" is the total product of the industry from its beginning to and including 1917.

Organization of the Salmon Canning Industry. In the salmon canning industry centralization of control had reached such a point in 1917 that five companies, or groups of companies, with a unified control, in 1917, packed 53.4 per cent of the total output.

From a business point of view there are several advantages in large-scale production and also in large business units controlling several salmon canneries. Among these are reduction of local hazard, better credit facilities, ability to own a fleet, and ability to secure and to utilize the best trap locations.

A company with several canneries is able to equalize or absorb local losses without incurring a deficit for the season. The salmon run varies from year to year, not only from district to district, but within any one district. A large company may have a small run in one locality, thus depleting the supply of raw fish for one cannery, but it is not likely to have a small run in every locality. For instance, a company with six plants in 1917 lost $115,000 at one plant and yet made a net profit on canning operations of over $1,000,000. A canner with only one plant, however, especially if in a location where

fish run irregularly, may have very uncertain profits. One year his profits may be very large and the next year he may have a heavy loss.

A large amount of seasonal capital is needed, and in getting necessary banking support, the packer who can show great stability over a period of years has the advantage. A packer should also show considerable surplus, so as to be able to withstand a poor season. The large canner has a distinct advantage over the small canner, speaking generally, in the seasonal borrowing of capital. The large companies, with their large output and with capital or credit sufficient to carry the bulk of their pack for several months, also have an advantage in the marketing of their product. In recent years the Puget Sound canners have experienced more credit difficulties than the Alaska canners who have offices in San Francisco. These large Alaska companies have been able to build up strong banking connections.

A large canner is able to own his own fleet and this is another advantage, for it gives him greater certainty of getting his supplies and enables him to move materials and labor from one plant to another as necessitated by the size of the salmon run in various localities. The large canner is also able to spend more money for exploration or search for new trap locations, or to buy desirable locations from others. The control of such desirable locations gives such canners a decided advantage.

Furs.[1] Since 1867 Alaska has produced furs to the value of about $90,400,000, of which about $53,000,000 represents the value of the sealskins. The value of the Alaska furs has increased from $761,729 in 1913 to $2,288,170 in 1918. Of these amounts $66,095 in 1913 and $924,570 in 1918 represent the value of the fur seals killed by the government on Pribilof Islands.

The raising of foxes and other fur-bearing animals is on the increase in Alaska, and promises to become a more important industry. The evidence in hand indicates that Alaska will continue to yield a valuable annual fur product. The fur seals promise to be a large source of annual revenue to the government.

[1] Taken from "Report of Alaska Advisory Committee" appointed by Hon. John Barton Payne, Secretary of the Interior, in *Report of the Governor of Alaska to the Secretary of the Interior*, 1920, p. 108.

8. THE TRANSPORTATION PROBLEM[1]

In order to understand the conditions affecting transportation a brief statement of the topography is desirable. Alaska is a Territory of great size, about one-fifth that of the total area of the United States. About a quarter of its area lies north of the Endicott Range, which is itself north of the Arctic Circle. This portion of the Territory is Arctic, and it alone presents the bleak and frozen aspect popularly associated with Alaska. South of this range in Alaska there is an area greater than that of all the states east of the Mississippi and north of the Ohio River and Mason and Dixon's line, which is as capable of high development as many well-settled and rich countries.

The Pacific Mountain system fronts the coast, extending from British Columbia in a huge arc and tailing out in the Alaska Peninsula. This system is widest in the several ranges which divide central Alaska from southern Alaska, just north of Prince William Sound, and stands as a barrier separating the comparatively small coastal valleys from the two great inland valleys of the Yukon and the Kuskokwim, which themselves are separated by a comparatively low divide. Both these great valleys may be described as regions characterized by broad, open bottom lands and gently rolling uplands.

River Navigation. The Yukon River, draining the greater of these basins, enters the Bering Sea at a latitude which prohibits the use of the stream as a connection with ocean-borne commerce except during three summer months. The same may be said of the Kuskokwim, though ocean commerce may reach its mouth for an additional month. Both of these rivers have difficult entrances, that of the Yukon being a shifting channel of little depth across the mud flats, and the entrance to the Kuskokwim a long and tortuous channel through sand bars, which, however, a careful navigator may follow by means of the recently published charts. Once inside, however, each presents a long stretch of navigable water for the ordinary river boat. The Yukon is navigable up to Whitehorse in Canada, about 2,200 miles, and its greatest tributary, the Tanana, is navigable without difficulty to Chena, and generally to Fairbanks, and at times much farther, though with difficulty. The Kuskokwim is navigable to the Forks, about 50 miles above the Takotna, or about 650 miles

[1] Adapted from *General Information Regarding the Territory of Alaska, Edition of September, 1918, Department of the Interior, Office of the Secretary*, pp. 9, 43–50.

from the mouth. Both of these streams have navigable tributaries which extend their scope as transportation routes and together provide about 5,000 miles of navigable waters in the two systems. The open season is about three to three and one-half months, and although short and though navigation is subject to occasional brief interruption in places by low water, there is a possibility of their utilization as transportation routes in the development of the two great valleys that will suffice for years to come.

There are other lesser valleys with navigable waters. Of these the Copper and Susitna are the most important. These two rivers are more important as offering the best possibilities of penetrating the coastal range by rail lines than for purposes of navigation. The Copper River breaks through the Chugach Range, but with a slope so steep as to make navigation difficult and hazardous, though not impossible. It is believed that the transportation possibilities of the stream are not worthy of serious consideration, although some stretches of it may be used to some extent for local business. The Susitna, in its lower reaches, is navigable for river boats, though its entrance from Cook Inlet is difficult. It has possibilities of assisting as a transportation route on a small scale.

Ocean Service. A number of good harbors along the Pacific seaboard of Alaska are now connected with nearby inland points by railroads and trails or by wagon roads and trails only. All these harbors as far west as Cook Inlet are open throughout the year and are from 1,000 to 1,400 statute miles from Puget Sound ports. There is service throughout the year from Seattle to southeastern and southwestern Alaska ports (Ketchikan to Seward), also westward from Seward to points on the Alaska Peninsula; but there is only summer service to Nome and St. Michael. A small steamer makes weekly trips between Juneau, Sitka, Skagway, and way ports.

In general the severest storms along the Pacific seaboard of Alaska are from the south and southeast. These are more frequent from October to March than during the balance of the year. As regards shipping the most important climatic features of the coast of Alaska are the severe winds which blow in and out of the valleys that traverse the coast ranges and their connecting fiords. These blow toward the land in summer and toward the sea in winter. The severest are the outward winds, which are most common during

January, February, and March, when velocities of 60 and 70 miles an hour are said to be not infrequent. Where a harbor or roadstead lies in the tracks of such winds they will seriously interfere with shipping. Examples of these winds are found at Lynn Canal, Bering River, Copper River, Lowe River, Valdez Glacier, Resurrection River near Seward, Iliamna Bay, and many other localities. The fogs in summer and the snowstorms in winter also at times delay vessels navigating the Alaska coast.

Railroads. The following table gives data as to mileage, terminals, and gauge of existing railroads in Alaska:

	Miles
Southeastern Alaska:	
White Pass and Yukon route, Skagway to White Pass (narrow gauge). Terminal at White Horse, Yukon Territory—total mileage, 112 miles	20.4
Yakutat Southern Railway, Yakutat to Situk River, with branch line to Lost River (Standard gauge)	19.0

Government Railroad:

The route adopted is known as the Susitna route, and extends from Seward, on Resurrection Bay, to Fairbanks, on the Tanana River, a distance of 470 miles. It includes the existing Alaska Northern Railroad, which runs from Seward through the Kenai Peninsula for a distance of 71 miles to Turnagain Arm. This railroad has been purchased by the government for $1,150,000. From Turnagain Arm the railroad extends through the Susitna Valley and across Broad Pass to the Tanana River and from there to Fairbanks. It is to be a standard-gauge road. A side line is to run from Matanuska Junction into the Matanuska coal field, a distance of 38 miles. In all probability this railroad will be completed in the summer of 1922 for at the beginning of that year only 72 miles of track through the Broad Pass section was incomplete. When completed trains will be operated from Seward and Anchorage to Nenana on the Tanana River, where connection is made by means of a river ferry, with the narrow-gauge line into Fairbanks. It is hoped that the completion of the railroad and the building of wagon road feeders will give impetus to all industries in this section of the Territory.[1]

[1] *Report of the Governor of Alaska to the Secretary of the Interior, 1921*, pp. 17–18.

Seward Peninsula:	Miles
Seward Peninsula Railway, Nome to Shelton (narrow gauge)	80.0
Paystreak Branch, Seward Peninsula Railway (narrow gauge)	6.5
Council City & Solomon River Railway, Council to Penelope Creek (standard gauge)	32.5
Wild Goose Railway, Council to Ophir Creek (narrow gauge)	5.0
	547.0

Wagon Roads. Wagon roads and trails are being constructed by the board of road commissioners of Alaska under the supervision of the Secretary of War. The mileage of road and trail constructed and maintained is as follows: Wagon road, 920; winter sled road, 629; trail, 2,210; an increase in the present year of 18 miles of wagon road. The average costs per mile, including maintenance and all overhead charges since the beginning of the work, are: Wagon road, $3,144; winter sled road, $345; trail, $106.

9. COMMERCE OF ALASKA

The commerce of Alaska fundamentally is based on exports of the products of the mining and fishing industries and of imports of food, clothing, machinery, and other supplies for the people employed in those industries. From 1867 to 1919 the total value of the mineral, fish, and furs produced in Alaska amounted to $949,000,000. As practically all of the trade of Alaska is with the United States, the following tables, XLII and XLIII, constitute a survey of the trade of the territory.

The total exports from Alaska to all countries in 1920 amounted to $69,098,884.

TABLE XLII

VALUE OF THE COMMODITIES SHIPPED FROM ALASKA TO THE UNITED STATES IN 1917 AND 1920*

Commodity	1917		1920	
	Quantity	Value	Quantity	Value
Antimony ore	....	$8,972	....	....
Copper ore, tons	199,014	....	102,312	....
Copper ore, pounds	100,740,856	27,243,510	73,334,794	$14,006,477
Fish:				
Fresh, except salmon	12,747,266	1,112,602	9,187,615	970,013
Dried or cured (pounds)	6,524,525	292,805	5,281,565	350,207
Pickled (barrels)	27,964	295,621	48,001	674,714
Salmon, canned (pounds)	265,452,307	41,478,514	194,671,630	34,781,970
Salmon, all other (pounds)	16,641,213	1,296,224	7,807,558	1,127,036
Herring, canned (pounds)	1,663,580	243,549	515,044	49,789
Clams, canned (pounds)	1,997,019	261,245	261,870	43,493
Shrimps (pounds)	83,930	8,232	124,855	54,261
Fish fertilizer (tons)	1,196	37,752	4,177	359,025
Fish and whale oil (gallons)	1,015,167	706,674	1,648,062	1,144,139
All other fish products	....	60,264	....	138,369
Total fish products	....	45,793,452	....	39,693,016
Fur and fur skins	....	379,580	....	3,291,584
Gypsum (tons)	10,950	43,800	8,350	54,900
Lead ore (tons)	2,866	121,946	2,453	110,092
Lead bullion (pounds)	122,339	9,156	85,162	5,483
Marble (tons)	....	72,406	6,170	184,229
Palladium (ounces)	....	....	1,173	135,053
Platinum (ounces)	....	....	345	34,087
Tin ore (tons)	219	114,462	52	22,499
Lumber (feet b.m.)	95,000	3,380	1,109,000	50,515
Tungsten ore (pounds)	20,160	19,550	....	....
Reindeer meat (pounds)	38,295	6,531	256,449	61,865
All other Alaska merchandise	....	65,621	....	83,377
Gold and silver	....	14,939,440	....	7,413,751
United States goods returned	....	2,233,125	....	2,613,679
Foreign goods	....	536,446	....	582,385
Total	....	91,591,408	....	68,342,992

* Adapted from *Report of the Governor of Alaska to the Secretary of the Interior, 1918*, p. 78; *1919*, pp. 69–74.

TABLE XLIII

VALUE OF THE TOTAL IMPORTS AND OF THE PRINCIPAL COMMODITIES IMPORTED INTO ALASKA FROM THE UNITED STATES IN 1914 AND 1917 (FISCAL YEAR)

Commodity	1914	1917
Coal	$ 295,123*	$ 290,237*
Lumber	642,611	1,343,336
Hardware and machinery	5,069,453	10,183,517
Provisions	5,645,715	8,353,418
Liquors	645,890	802,471
All others	9,630,668	17,454,639
Total	$21,929,460	$38,427,618†

* Foreign coal was imported to the value of $108,355 in 1914 and $280,687 in 1917.

† In 1920 the total value of the imports into Alaska was $38,418,437, of which $36,876,855 was for imports from the United States. Of this total, imports to the value of $15,673,311 went to southeastern Alaska where Ketchikan and Juneau are the chief ports; imports to the value of $17,275,927 went to the points on the southern coast where Anchorage and Cordova are the chief ports.

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(Bold-faced figures refer to pages on which the subject is discussed directly.)

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YUKON RIVER
KUSKOKWIM BAY
DIXON ENTRANCE
West of Greenwich

ALASKA, MAP A